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OPERATION AND MAINTENANCE MANUAL FOR THE SOLID STATE READOUT DE--ETC(U)
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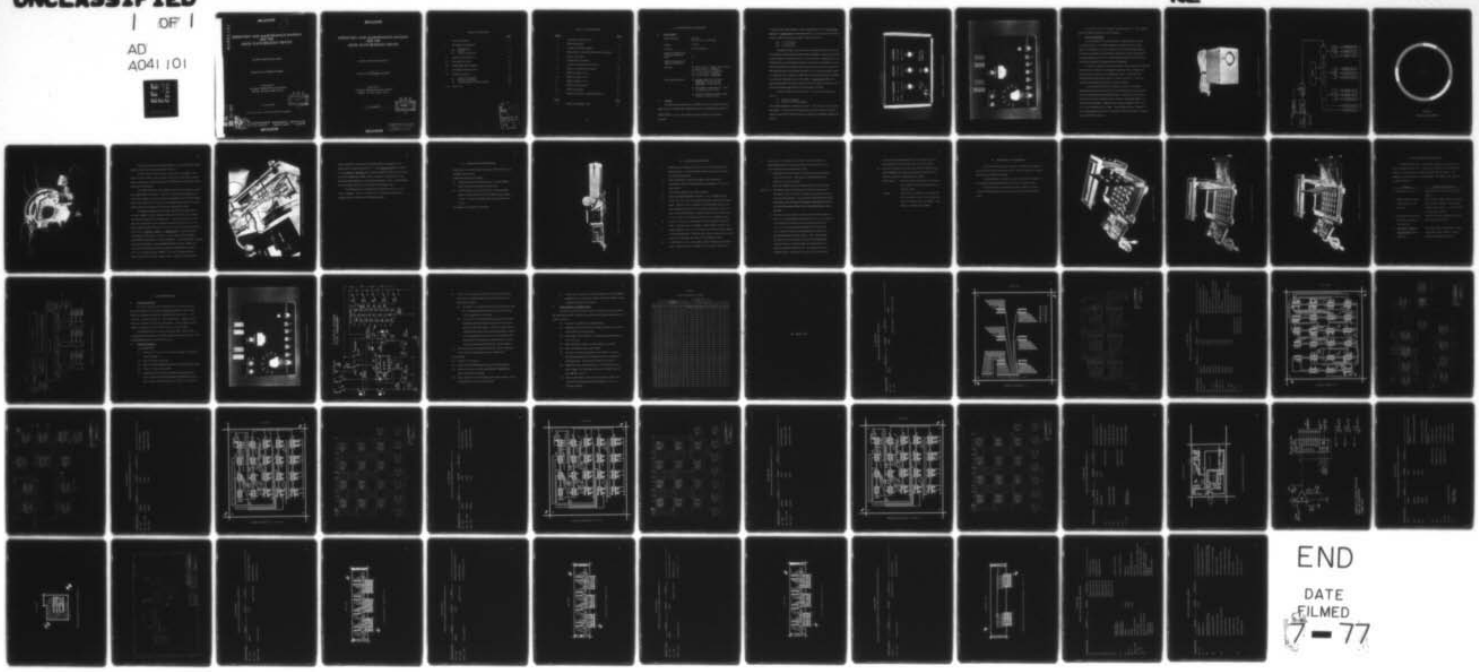

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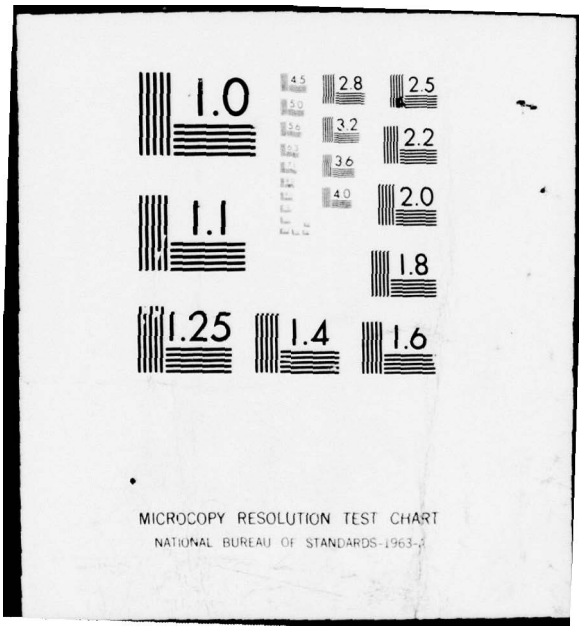
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4.0
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5.0
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6.3
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

OPERATION AND MAINTENANCE MANUAL FOR THE SOLID STATE READOUT DEVICE

Southwest Research Institute

Contract No. F41609-74-C-0017

Prepared for
Aerospace Medical Division (AFSC)
Brooks Air Force Base, Texas

24 June 1975

SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO CORPUS CHRISTI HOUSTON

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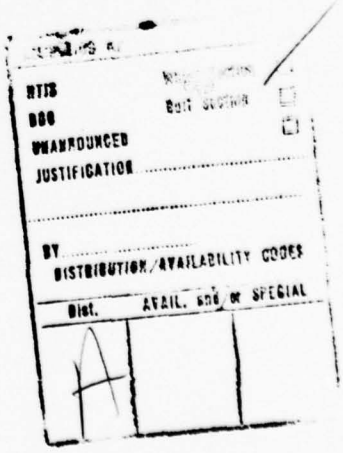
TABLE OF CONTENTS



LIST OF ILLUSTRATIONS

I. DESCRIPTION OF EQUIPMENT

A. Specifications

Power Required	42 watts volts 115 Vac, 0.408 amps
Weight	11.8 lbs
Accuracy	±0.4% maximum*
Number of Samples Per Wavelength Scan Segment	64
Number of Samples per Light Level Indicator	8
Switches	(1) Power On-Off - Toggle Two Position (2) Master Reset - Pushbutton (3) λ 2.5-4.5 Reset - Pushbutton (4) λ 4.5-8 Reset - Pushbutton (5) λ 8-14.5 Reset - Pushbutton
Front Panel Indicators	(1) Greater Than - Red, 24 total Equal To - Yellow, 24 total Less Than - Green, 24 total (2) Scan address lights (binary, 6 each for addresses from 0-63) (3) Analog-to-digital converter output (binary, 8 each for 8 bits)

B. General

The Solid State Readout Device (SSRD) is used in conjunction with the Wilks Miram I Variable Filter Infrared Analyzer to automatically indicate if

*Unit accuracy set at ±2.9% to allow for Wilks Analyzer and operator variation.

an unknown gas being sampled contains contaminants with levels less than, equal to, or greater than a predetermined level. The gas analyzer samples the gas in three wavelength (λ) bands. These bands are:

(1) λ = 2.5 to 4.5 Å
(2) λ = 4.5 to 8 Å
(3) λ = 8 to 14.5 Å

The digital readout system has been developed primarily to provide an automatic accept/reject indication during sampling of aviator's breathing oxygen (ABO) for contaminant levels. This is done by comparing the questionable gas to a predetermined tolerance level stored in the SSRD. Several different allowable contaminant levels have been set by various authorities. Maximum allowable contaminant tolerance levels to which the ABO sample is compared can be changed by replacement of read-only memories (ROMs). If, during the sampling process of the ABO, a greater than light is displayed by the SSRD, the ABO contaiminant has exceeded the tolerance level for the wavelength appropriate to the illuminated red lamp.

The basic SSRD is shown in Figure 1. Accessories to the basic unit are:

(1) ROM Programmer
(2) 220 Vac to 110 Vac Adapter

The ROM programmer is shown in Figure 2. This unit is used to program the ROMs (6 total) to the absorption level use limits which are predetermined using the Wilks Infrared Analyzer against an acceptable standard gas sample.

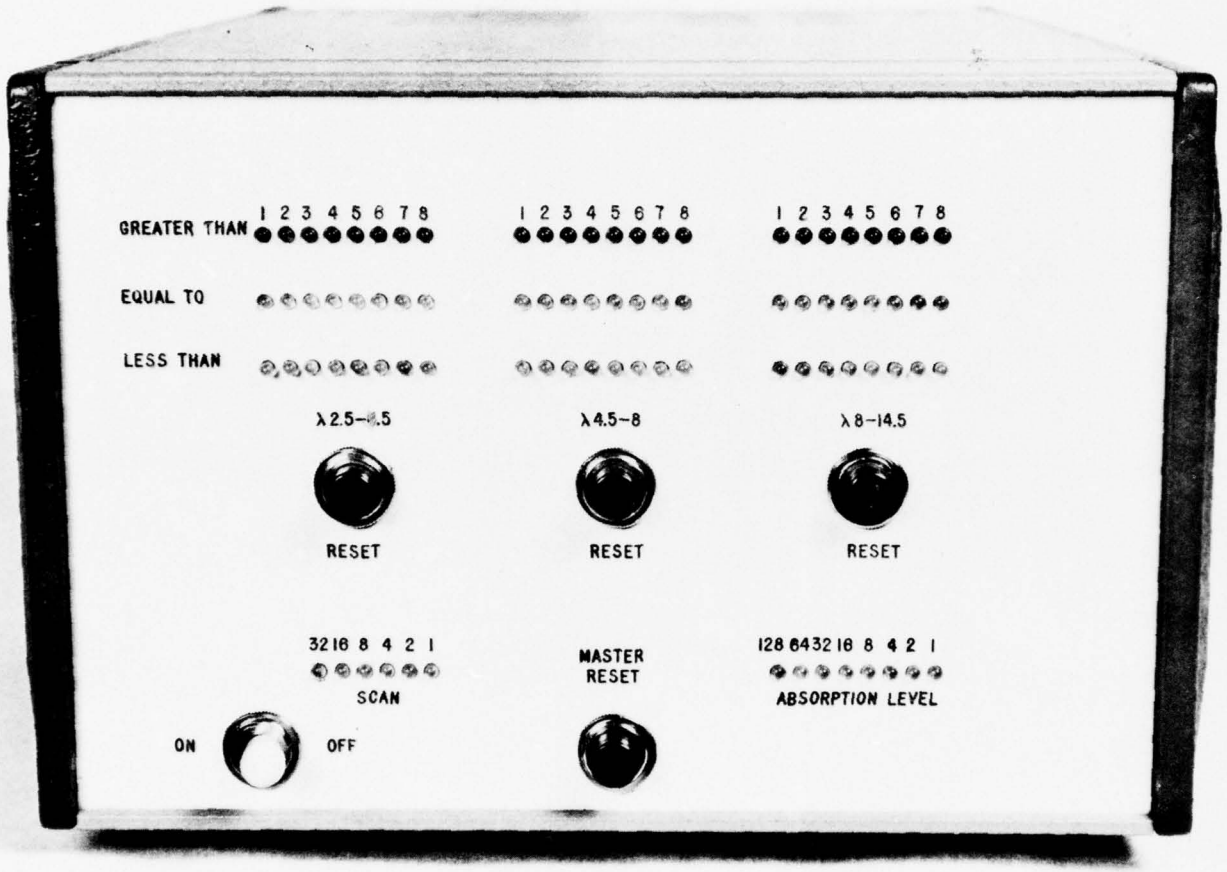


FIGURE 1. SOLID STATE READOUT DEVICE

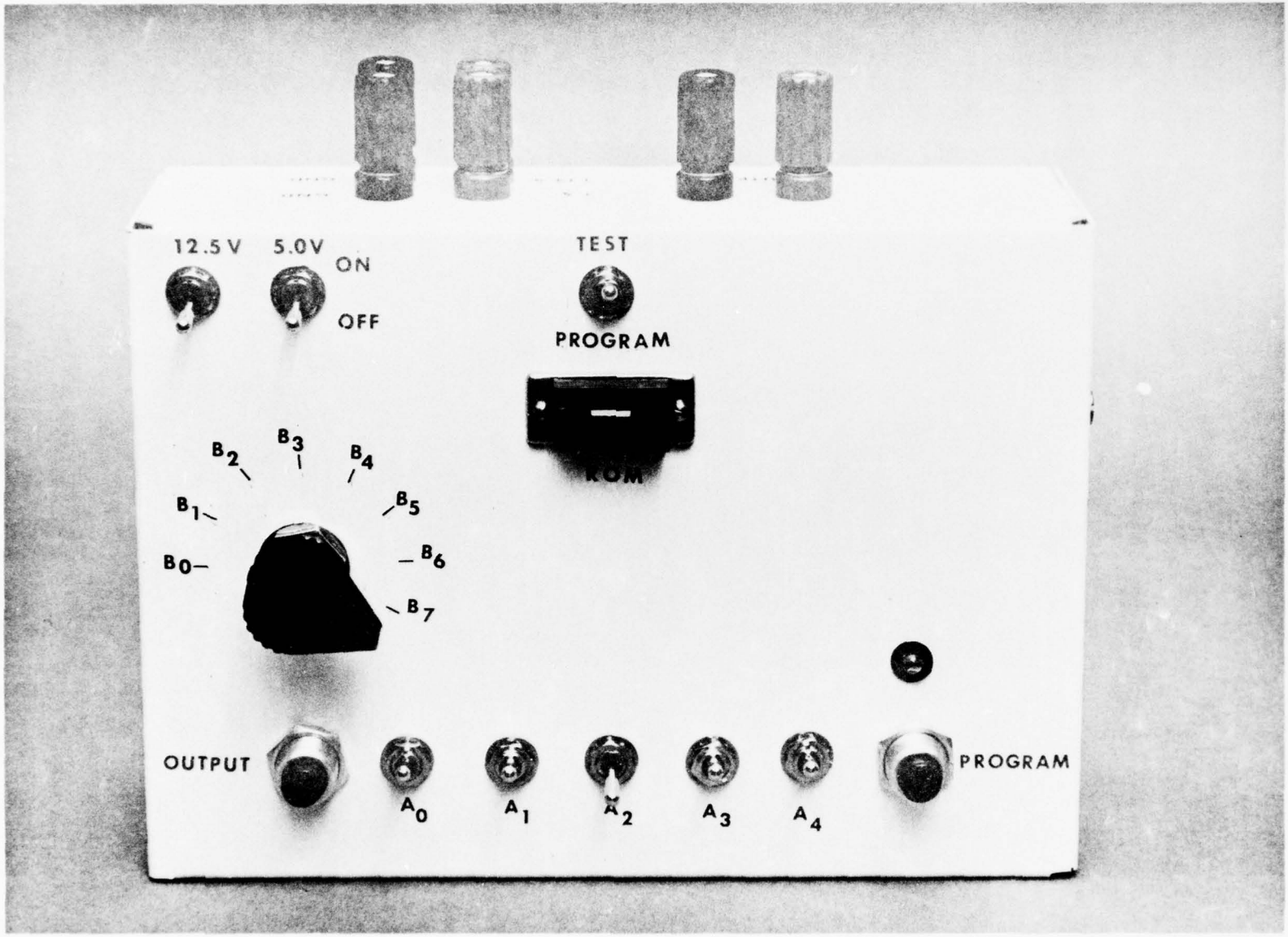


FIGURE 2. ROM PROGRAMMER

The 220 Vac to 110 Vac adapter is shown in Figure 3. This adapter allows the SSRD to operate on 220 Vac power.

C. Theory of Operation

A block diagram of the Wilks Analyzer operating with the SSRD is shown in Figure 4. The Wilks Analyzer provides an analog voltage output corresponding to the IR absorption level of the gas being analyzed. In order to determine the wavelength of the various gases being analyzed, a rotating analog optical filter is used between the IR source and detector to provide an analog scan proportional to wavelength.

In order to digitally measure the position of the optical filter wheel and therefore the instantaneous wavelength being measured, an optical code wheel (mask) was added to the analog filter wheel. The mask coded with alternate bright and dark spaces is shown in Figure 5. The mask mounted to the analog filter wheel is shown in Figure 6.

An IR emitter and detector contained in a TO-5 size package illuminates and receives reflections from the optical mask, detecting the transition between the dark and bright spaces. Each time the transition from dark to bright or bright to dark is detected, the digital address relating to the wavelength is updated and an analog-to-digital (A/D) conversion of the absorption level is taken. Through this process, 64 address and corresponding A/D levels are obtained for each of the three wavelength scans of the Wilks Analyzer.

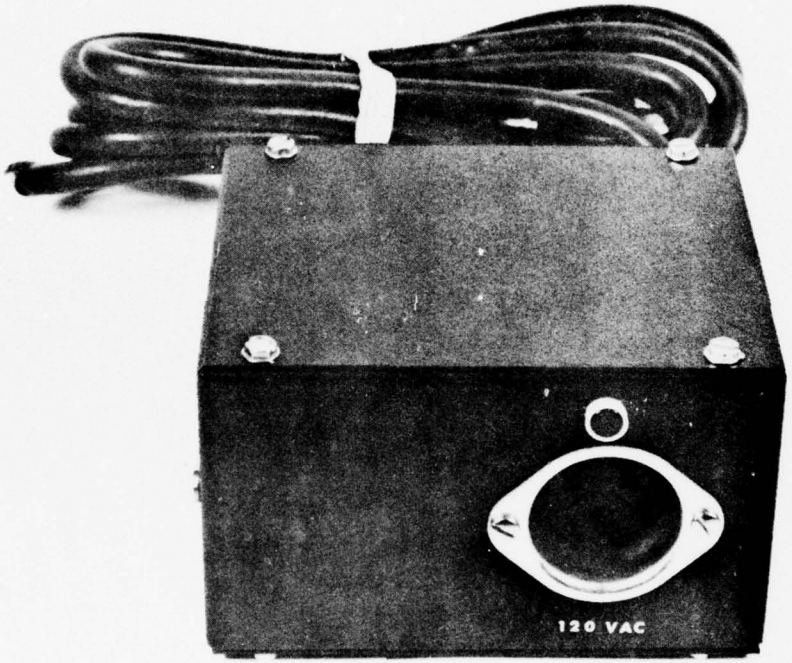


FIGURE 3. 110-200 VAC POWER ADAPTER

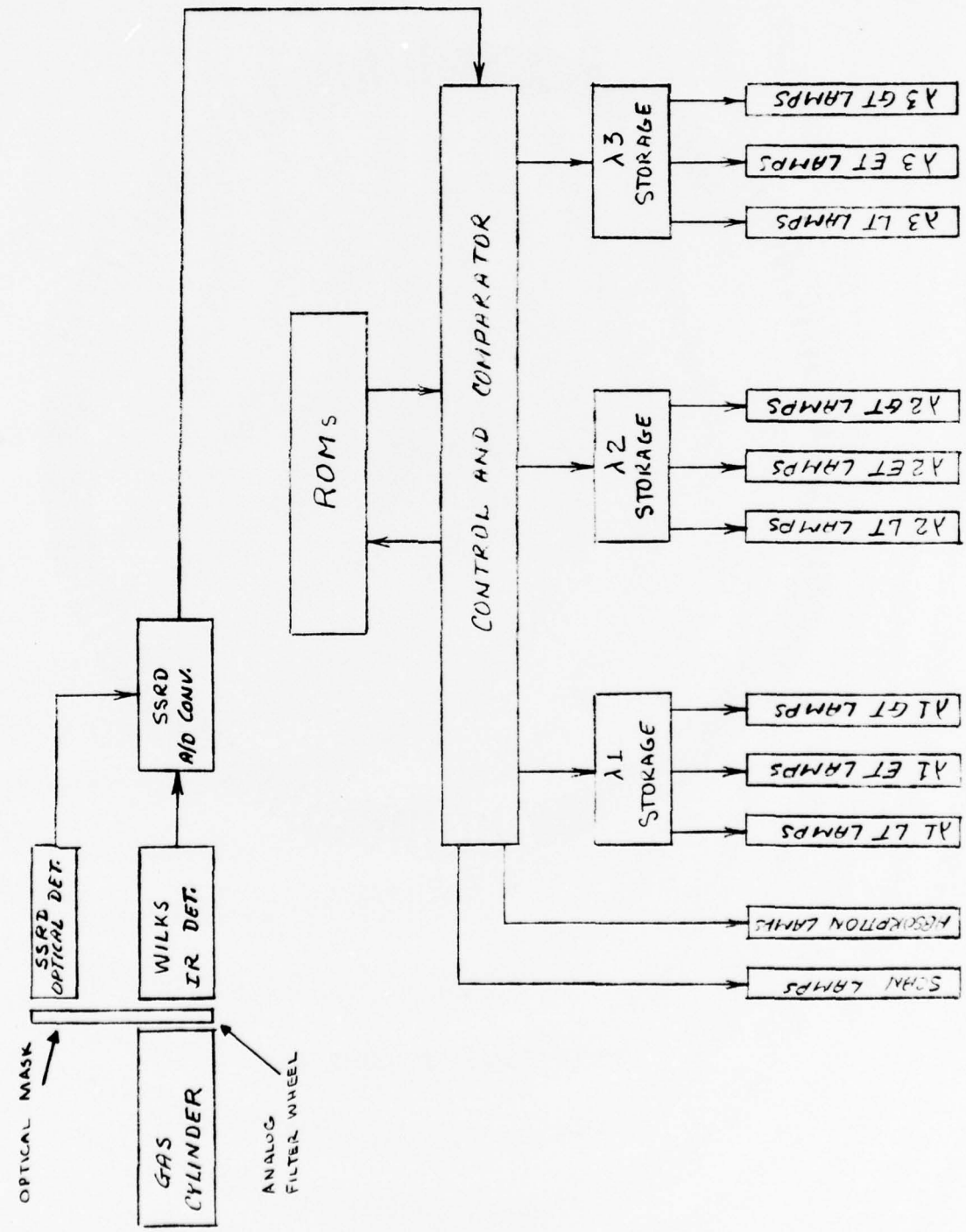


FIGURE 4. WILKS ANALYZER AND SSRD SYSTEM BLOCK DIAGRAM

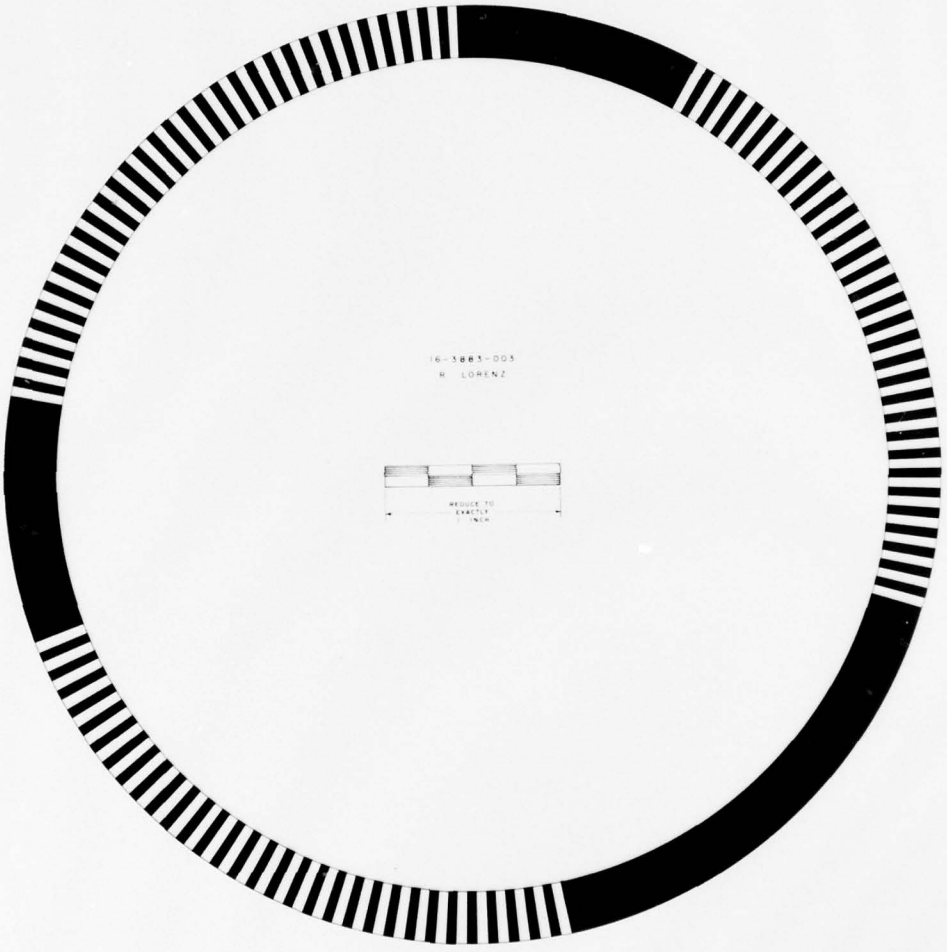


FIGURE 5

OPTICAL CODE WHEEL

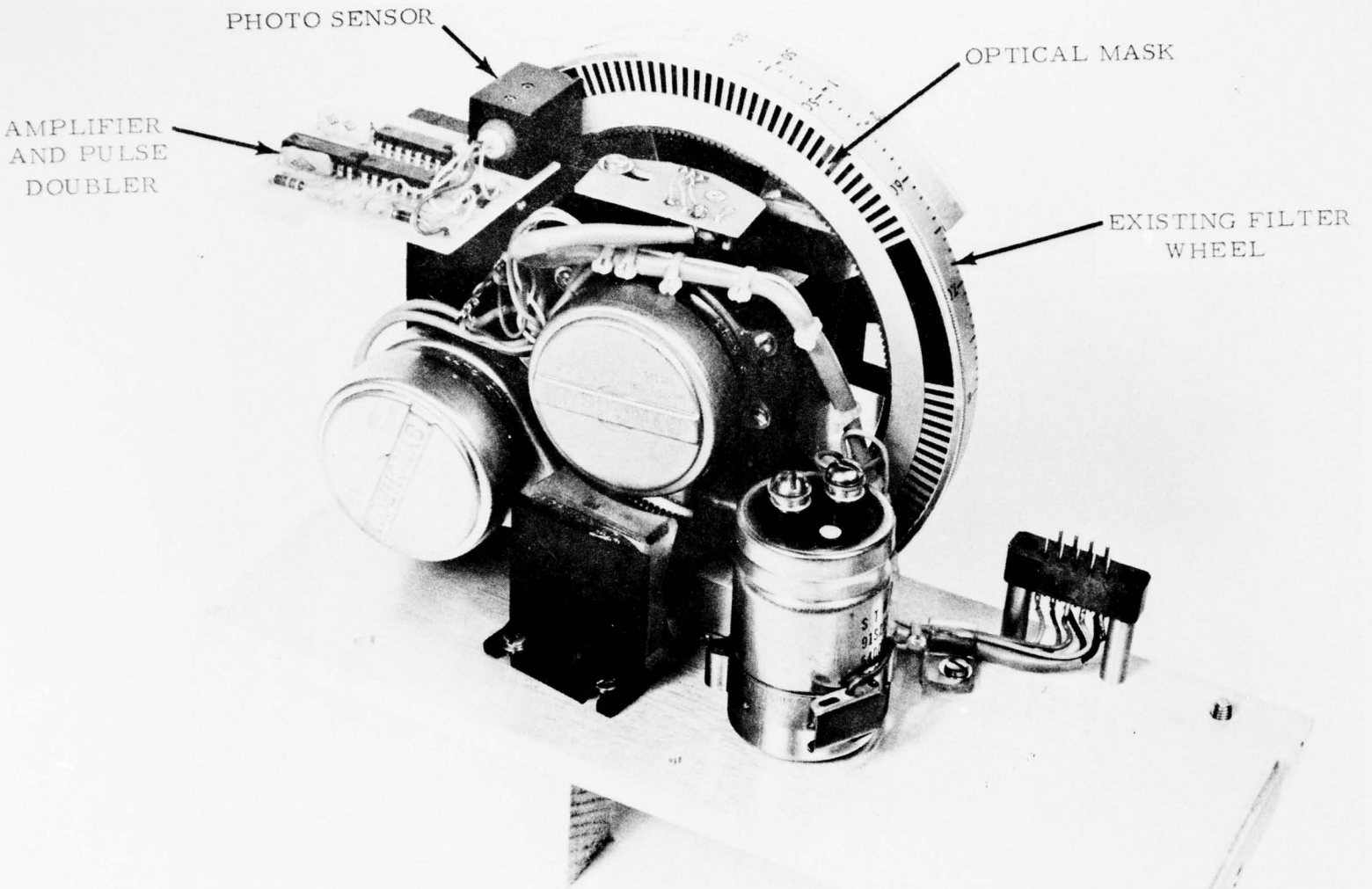


FIGURE 6

OPTICAL SENSOR MOUNTING

The A/D converter and scaling amplifier is mounted inside the Wilks Analyzer chassis in the position shown in Figure 7.

A single cable is used to connect the analyzer to the SSRD. This cable carries ±15 Vdc, +5 Vdc, ground, 8-bit A/D converter data, and the optical mask pulse. When disconnected, the SSRD does not alter the normal operation of the analyzer.

The ROMs provide the stored digital value of the use limits to which the sampled ABO is compared. There are sixty-four 8-bit digital words stored in the ROMs for each of the three wavelength scans (192 words total). Each of the sixty-four 8-bit words are sequentially addressed as the optical detector detects the position of the analyzer analog filter wheel.

The digital sampling process begins when the filter wheel moves to address 000001 which is detected causing the A/D converter to convert the analog absorption level to digital form. When this conversion is complete, the comparator circuit compares the output value of the λ 2.5-4.5 ROM at address 000001 (decimal 1 value) to the value of the A/D converter. If the value is less than, equal to, or greater than the stored use limits, the appropriate light (green, yellow, or red, respectively) for address group 000001 through 000111 will be illuminated. As the filter wheel continues and reaches the address position 000010 (decimal 2 value), another A/D conversion of the absorption level is made and compared to the value of the λ 2.5-4.5 ROM at address 000010. If the new comparison shows a change in light status so that a larger value is required, the appropriate

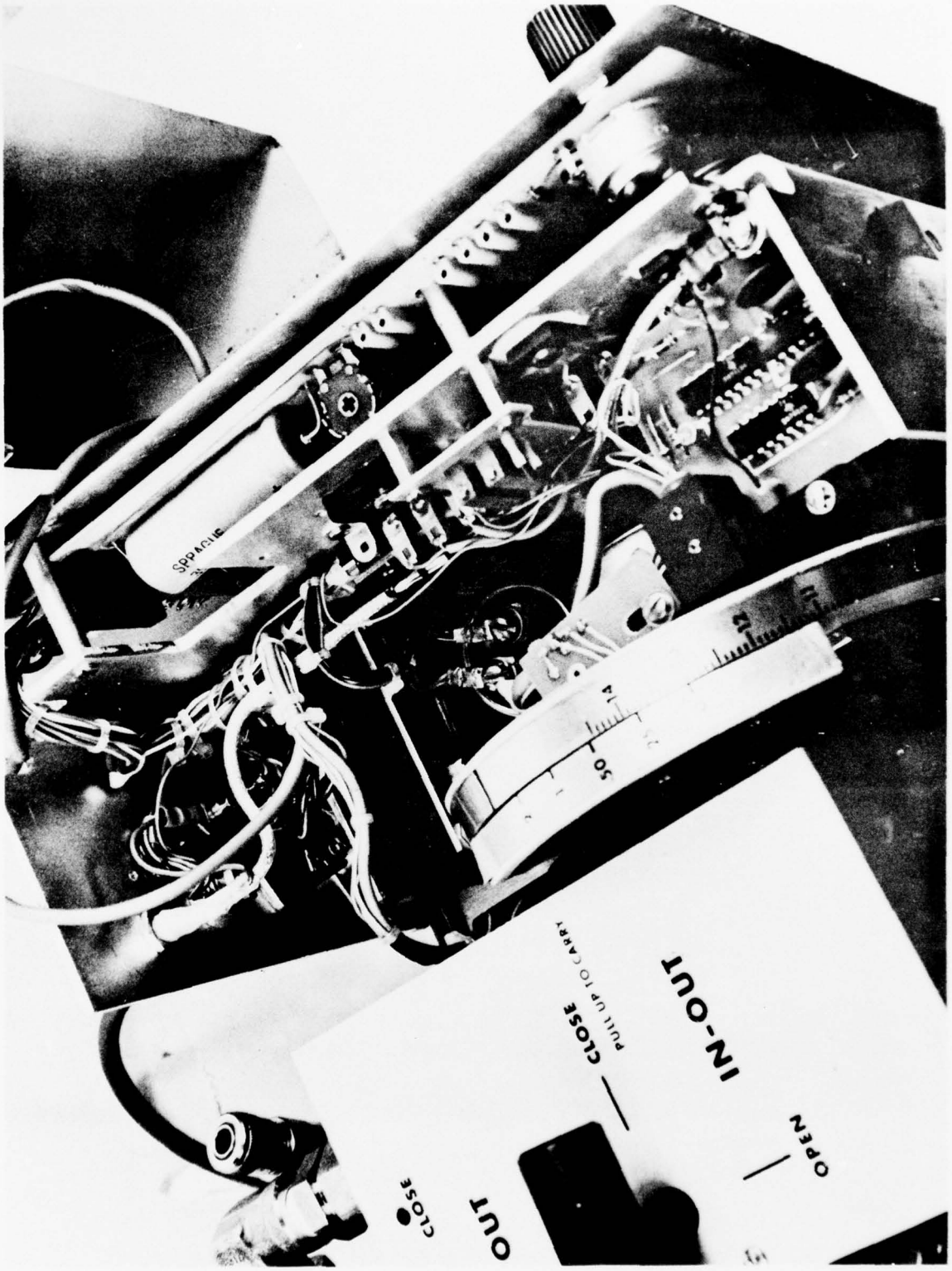


FIGURE 7. LOCATION OF A/D CONVERTER CIRCUIT

yellow (equal to) or red (greater than) lamp will be illuminated. The largest value is always preserved, i.e. if the greater than light is turned on, the equal to or less than light is always inhibited for that scan group run or until the appropriate RESET switch is pressed. Eight addresses are measured and compared for each light group (green, yellow, red) and there are eight light groups for each of the three wavelength scans.

The above process is automatically continued until the λ 2.5-4.5 scan is complete. The λ 4.5-8 and λ 8-14.5 scan and comparison are automatically accomplished in an identical manner.

II. INITIAL SET-UP PROCEDURE

1. Connect the one required cable between the Wilks Analyzer and the SSRD (see Figure 8).

2. Connect the AC power as follows:

   (a) If the AC power is derived from 115 V, plug the SSRD power cord directly to the AC power outlet.

   (b) If the AC power is derived from 230 V, plug the SSRD power cord into the 115 to 230 Vac adapter input marked 115 Vac. Connect the adapter power plug to the 230 Vac source.

3. The system is now ready for operation.

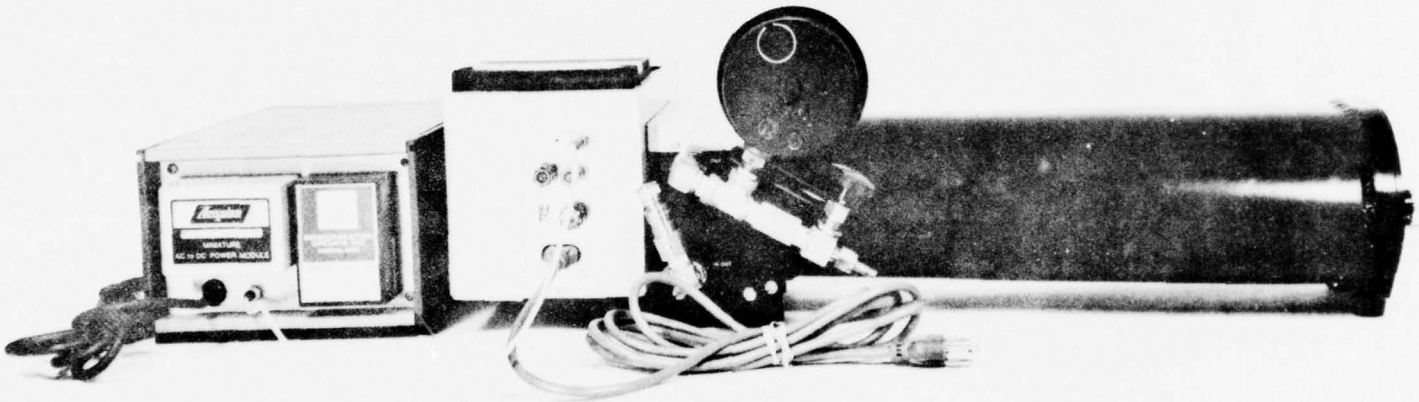


FIGURE 8. ANALYZER AND SSRD INTERCONNECT

III. OPERATING PROCEDURE

1. Follow the prescribed procedure for turn-on and loading of the Wilks analyzer. Set the maximum deflection and zero as called for in those instructions.
2. Place the ON-OFF switch of the SSRD to the ON position.
3. Set the filter wheel to the blank space proceeding the 2.5 to 4.5 A scan section.
4. Turn on the automatic scan of the analyzer.
5. Press the MASTER RESET, then the λ 2.5-4.5 RESET switch.
6. As the λ 2.5-4.5 scan is proceeding, note the changing of the SCAN lights. When the scan is complete, all SCAN lights should be off.
7. Upon completion of the λ 2.5-4.5 section, let the filter wheel continue to move automatically. While the filter wheel is between the λ 2.5-4.5 and λ 4.5-8 position, press the λ 4.5-8 RESET switch.
8. As the λ 4.5-8 scan is proceeding, note the changing of the SCAN lights. When the scan is complete, all SCAN lights should be off.
9. Upon completion of the λ 4.5-8 section, let the filter wheel continue to move automatically. While the filter wheel is between the λ 4.5-8 and λ 8.14-5 position, press the λ 8-14.5 RESET switch.
10. As the λ 8.14-5 scan is proceeding, note the changing of the SCAN lights. When the scan is complete, all scan lights should be off.

11. If an error occurs during a scan section, such as the analyzer being bumped causing a transient signal to be generated, the scan can be repeated by the following procedure:

a. Manually set the filter wheel to the blank space preceding the scan sector desired. (This can be accomplished while the analyzer is in the scan mode.)

b. Press the RESET switch associated with the scan to be taken.

Notes: (1) Transients produced by turning the automatic scan motor of the analyzer "ON" can cause an address change and will access the wrong ROM address. Always TURN THE SCAN SWITCH OF THE ANALYZER ON BEFORE PRESSING THE RESET SWITCH ON THE SSRD ASSOCIATED WITH THE APPROPRIATE SCAN SECTOR.

(2) In order to produce better resolution from the Wilks analyzer, there is a wavelength path change made in the λ 2.5-4.5 sector. At the present, the last two sets of indicator lamps of the λ 2.5-4.5 sector associated with address 101111 through 111111 require a different wavelength path to compare the sample against the stored use limits. This requires that the sector must be run twice, first at the wavelength path used for the first 6 indicator lights associated with scan addresses 000000 through 101110. Disregard the last two indicator lamps. Repeat the scan procedure for the entire

scan when the wavelength path has been changed, this time disregarding the results of the first six indicator lights.

(3) The above procedure is not the only method of obtaining data. Understanding of the control functions may provide the user with other options for utilization of the SSRD:

Master Reset: Sets the system so that none of the three λ scan sections are activated and clears all indicator lights.

λ Reset: Enables the scan address to the ROMs for the associated λ sector. After completion of 64 scan address, the scan address to the ROMs is automatically inhibited.

IV. DISASSEMBLY AND ASSEMBLY

All circuit boards and power supplies contained in the SSRD can be accessed by removing the chassis top. Figures 9 through 11 indicate how the circuit boards are hinged.

All board numbers reference the top circuit board as Number 1, in sequential order through Number 5 (the last or bottom board).

The A/D converter and optical detection system are located inside the Wilks Analyzer and are accessed by removing the housing cover.

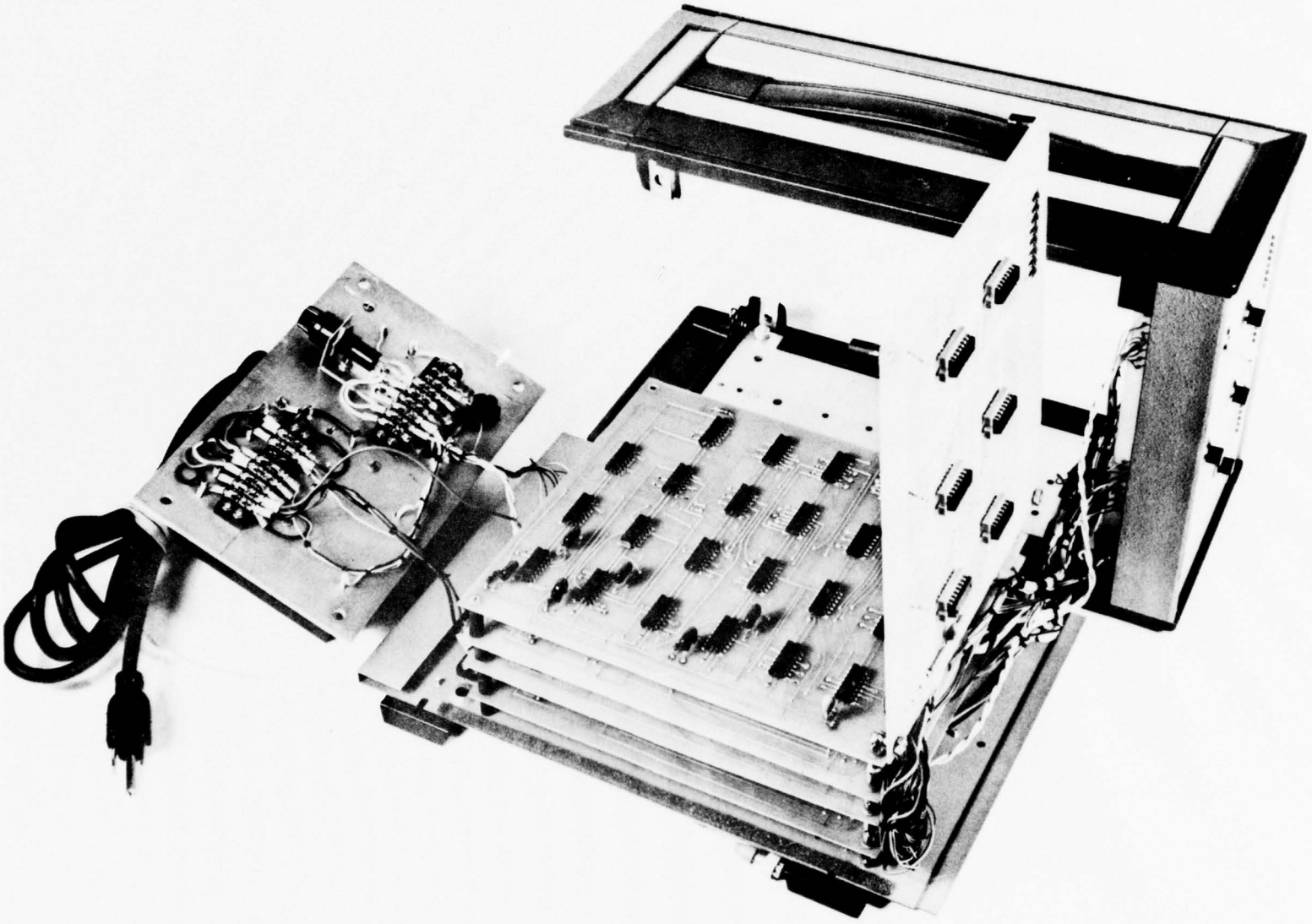


FIGURE 9. SSRD ASSEMBLY, VIEW 1

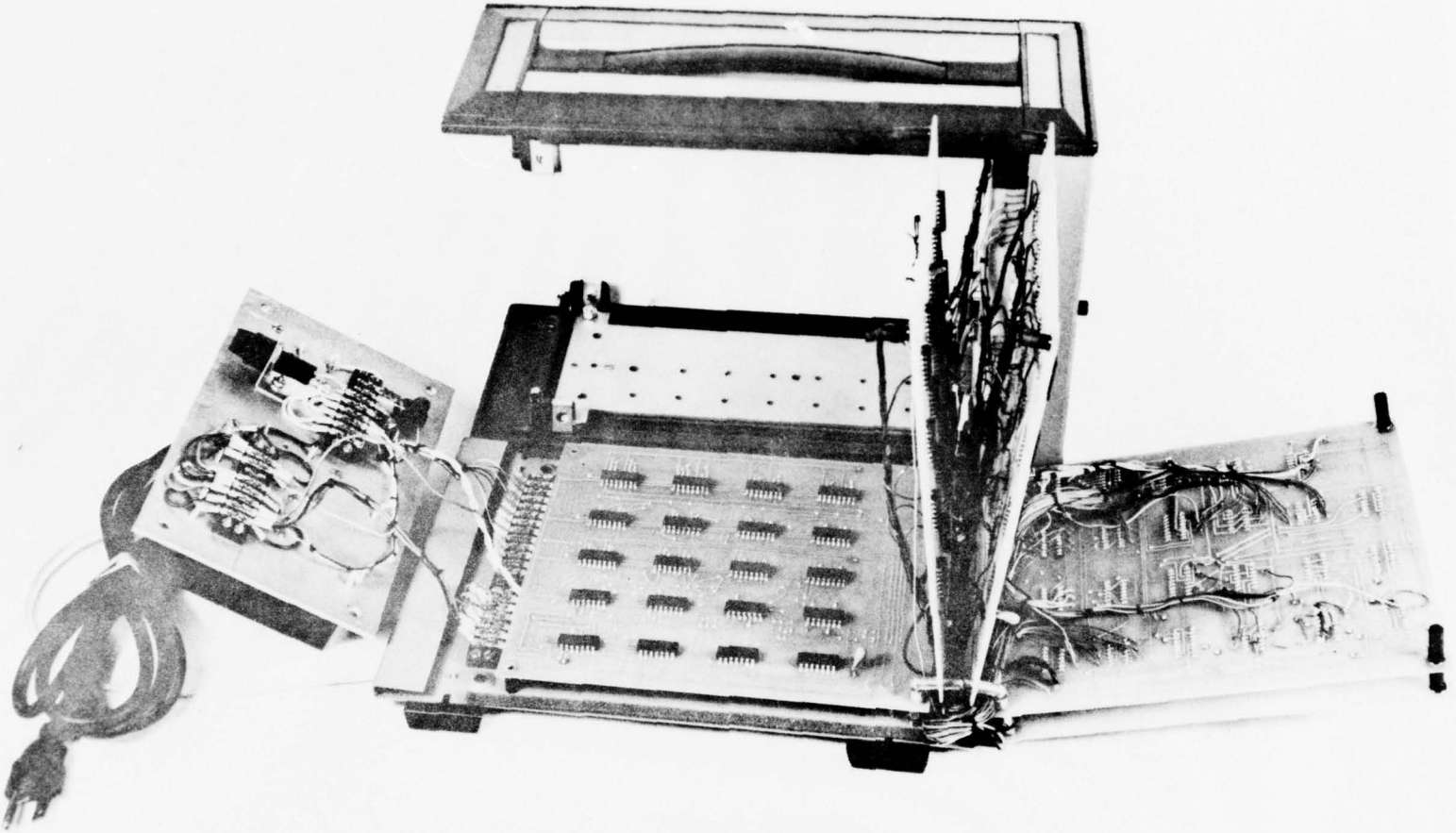


FIGURE 10. SSRD ASSEMBLY, VIEW 2

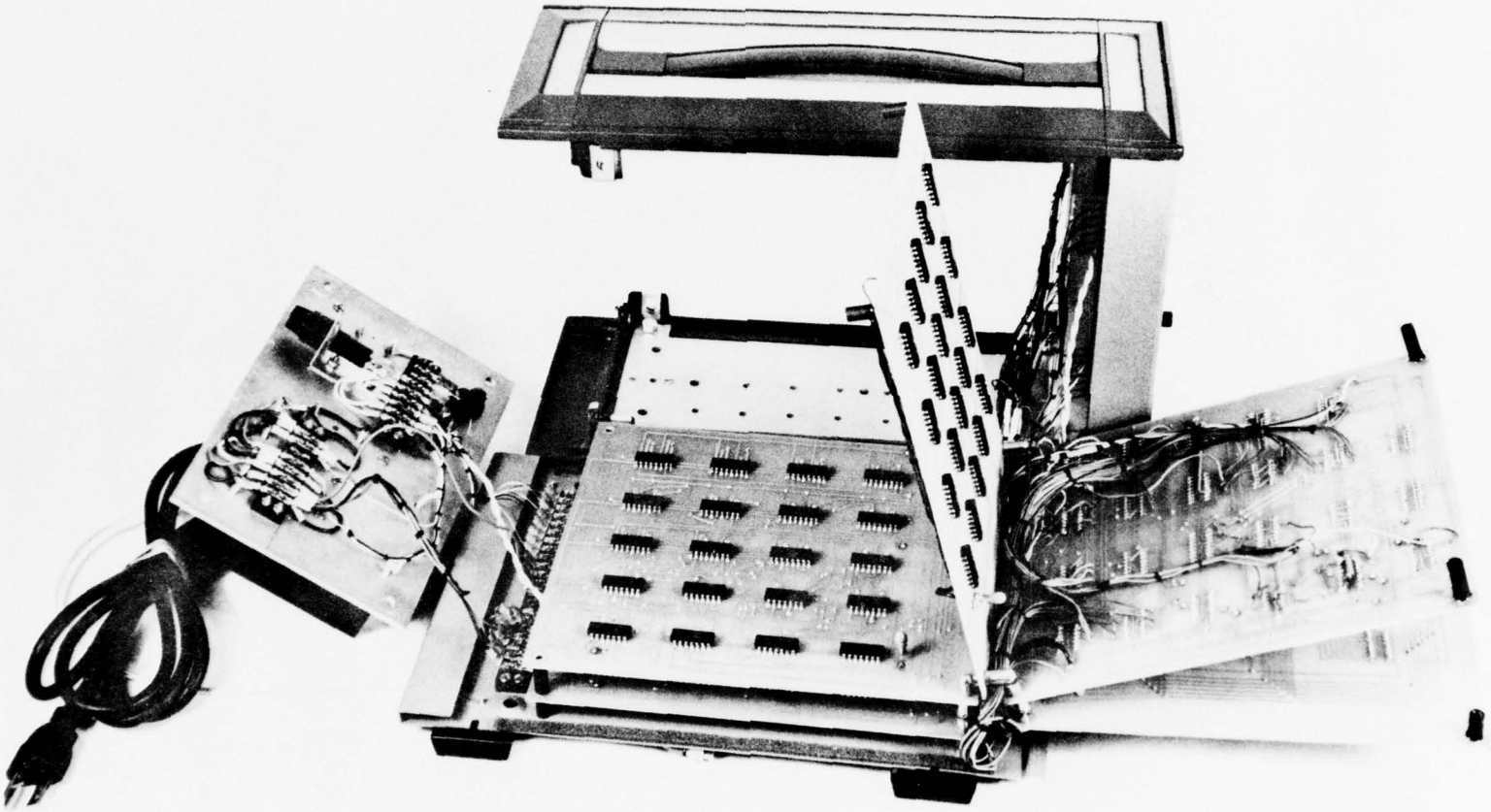


FIGURE 11. SSRD ASSEMBLY, VIEW 3

V. TROUBLESHOOTING PROCEDURE

The following procedure is intended to isolate the general area in which a malfunction may occur. Repairmen should have a good knowledge of digital circuits in order to isolate individual logic IC failures. All output pulse levels should be TTL compatible. The SSRD overall schematic is shown in Figure 12.

Symptoms	Probable Trouble Area
1. SSRD fails to operate.	Check power fuse; check power supply outputs.
2. Address indicator lamps do not change as scan proceeds.	Check output of optical detector for trigger pulses to A/D converter. Check status output of A/D converter. Check operation of counter Q10, Board 2.
3. Absorption level indicator lamps do not change as scan proceeds.	Check A/D converter analog input. Check lamp drivers Q2, Board 2.
4. Less Than, Equal To, Greater Than lamps inoperative.	Check DC voltage to lamp boards. Check enable input of Q17, Board 3. Check comparator output Q8, Board 2.

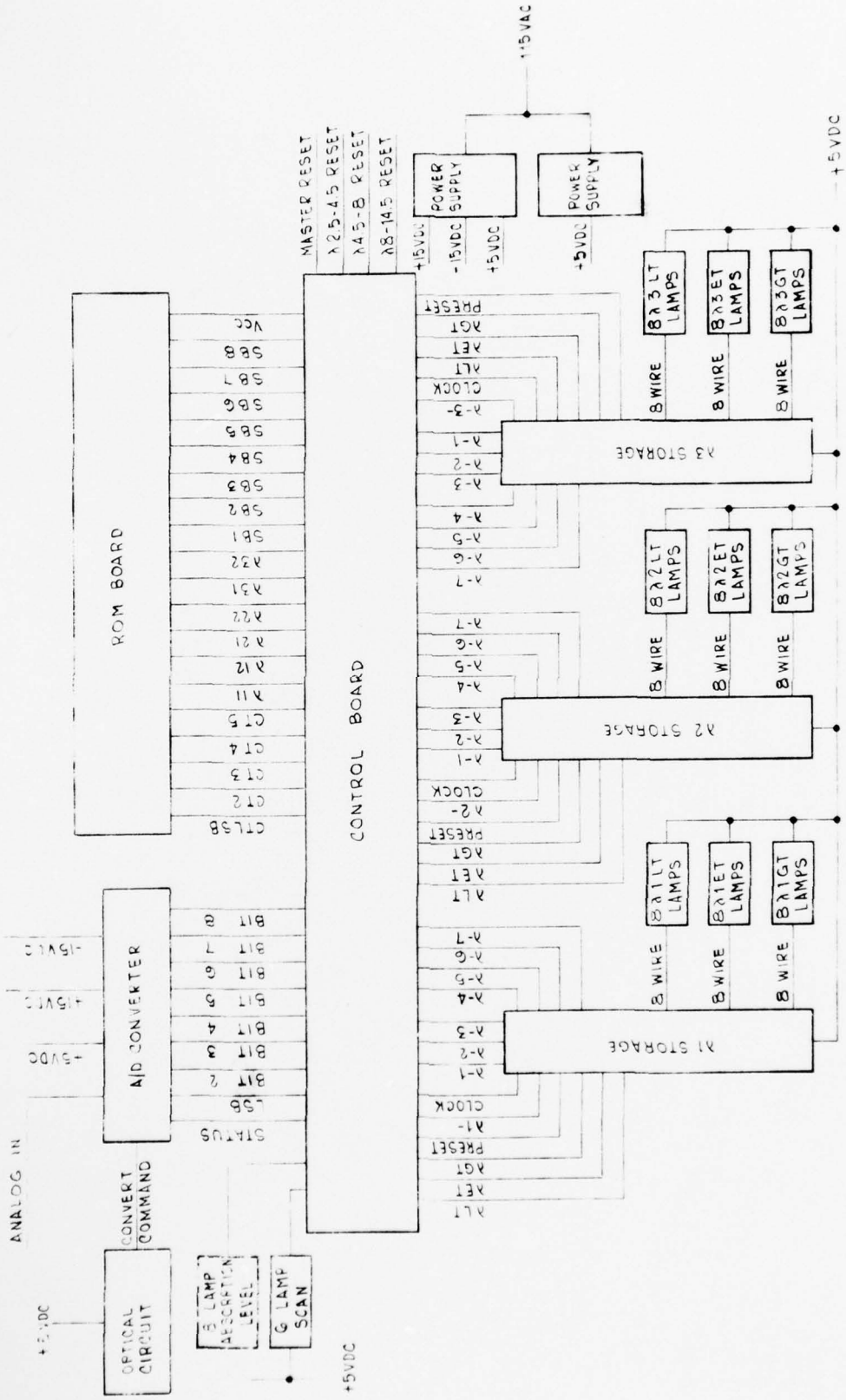


FIGURE 12. SSRD OVERALL SCHEMATIC

VI. ROM PROGRAMMER

A. Theory of Operation

In order to preserve the use limits value for comparison to the gas being analyzed, field or lab programmable ROMs are used. These ROMs are programmed using the equipment shown in Figure 13. The schematic is shown in Figure 14. Two external power supplies (not provided) are required to operate the programmer. These supplies must be capable of providing +5 Vdc at 250 ma and +12.5 Vdc at 250 ma.

The ROMS consist of a matrix of fuseable links. When a logic 1 is programmed at an address, the ROM programmer applies the +12.5 Vdc for approximately 50 ms which opens the fuse.

B. Method of Operation

To program ROM:

(1) Connect the +5 Vdc and +12 Vdc power supplies to the appropriate terminals.

(2) Turn +5 V power switch ON.

(3) Place the TEST-PROGRAM switch to the PROGRAM position.

(4) Turn 12.5 V power switch ON.

(5) Using the previously filled out ROM programming form, set A switches to the desired BINARY ADDRESS (for logic 1, push switches forward; for logic 0, switches are vertical).

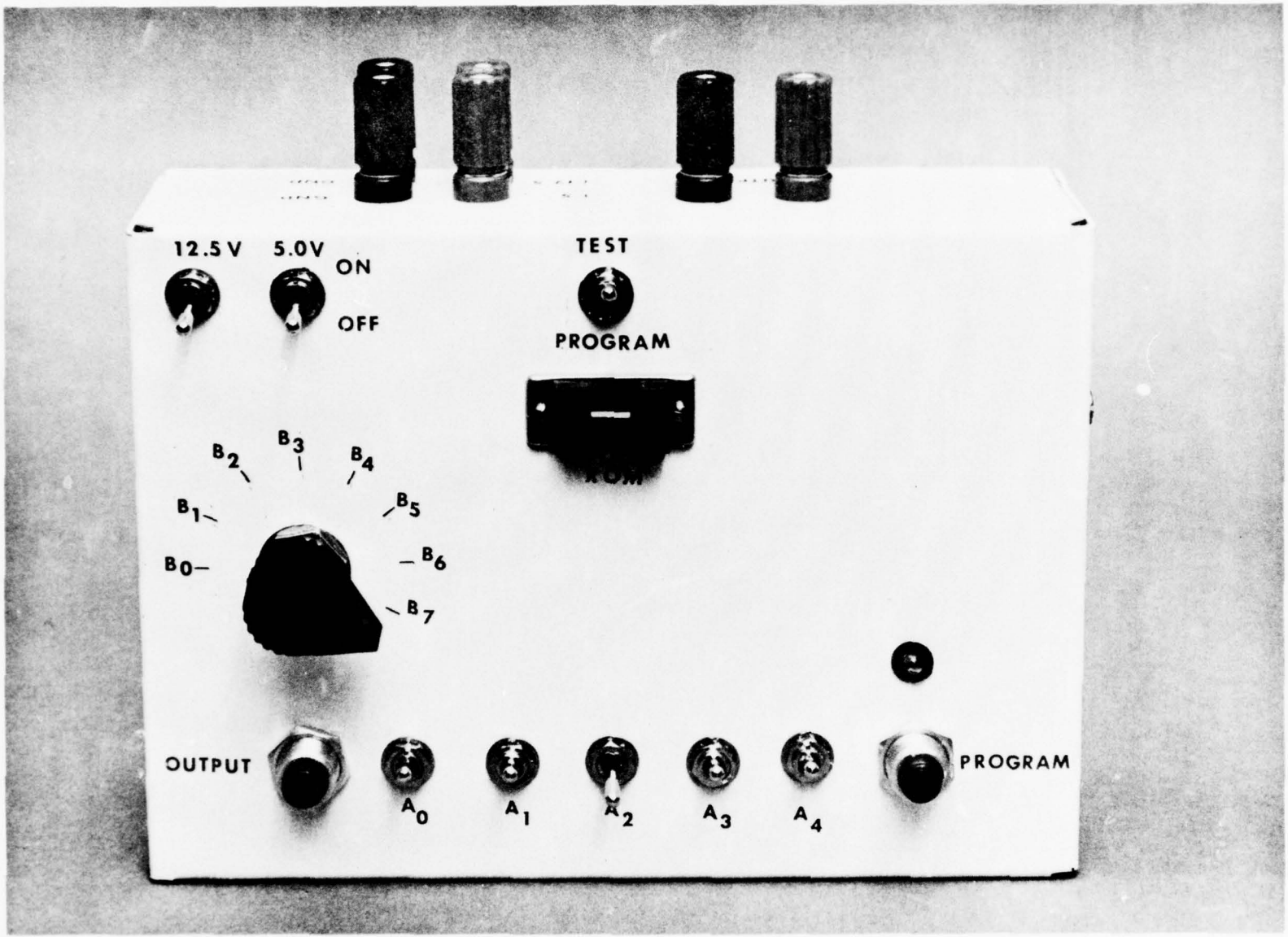


FIGURE 13. ROM PROGRAMMER

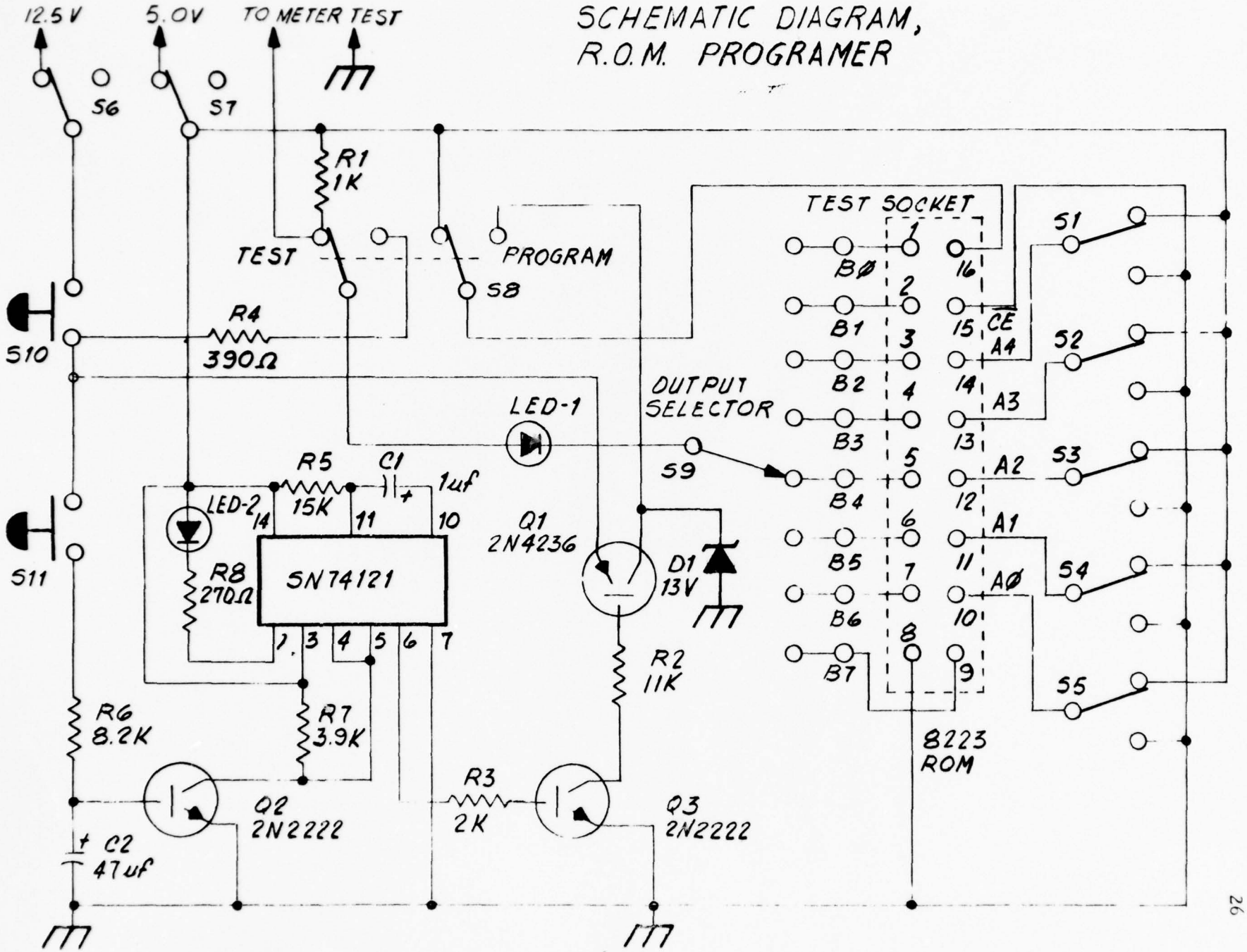

SCHEMATIC DIAGRAM,
R.O.M. PROGRAMER
12.5 V
5.0V
TO METER TEST
S6
S7
R1
1K
TEST
PROGRAM
S8
S10
R4
390Ω
TEST SOCKET
S1
S2
S3
S4
S5
OUTPUT
SELECTOR
S9
LED-1
R5
15K
C1
1uf
LED-2
R8
270Ω
SN74121
Q1
2N4236
D1
13V
S11
R2
11K
R6
8.2K
R7
3.9K
R3
2K
Q2
2N2222
Q3
2N2222
C2
47uf
8223
ROM
B0
B1
B2
B3
B4
B5
B6
B7
CE
A4
A3
A2
A1
A0

FIGURE 14.

(6) For the corresponding use limit on the ROM programming form, place the output selector switch (B0 through B7) in the desired position.

(a) If a logic "0" is required for any specific bit B0 through B7, no programming for that bit is necessary as this is the original level of the ROM.

(b) If a logic "1" is to be programmed, depress the output pushbutton and hold while pressing the program pushbutton one time and release. After the signal light has flashed (located above the program pushbutton), release the output pushbutton and select the next output bit (B0 through B7) to be programmed until all logic 1 level B bits have been programmed for the selected address.

(7) Repeat this process beginning with Step 5 until the ROM has been completely programmed for all 32 addresses.

To test ROM:

(1) Connect +5 Vdc power.

(2) Place the TEST-PROGRAM switch to the TEST position.

(3) Set the A switches to the desired BINARY ADDRESS (for logic 1 push switch forward).

(4) Select output to be tested by placing the output selector switch (B0 through B7) to the desired position.

(5) Read the logic level by observing the light above the PROGRAM pushbutton or by connecting a VOM to the TEST METER outputs available on the top of the chassis.

C. Obtaining Data to Program ROMs

In order to program the value of the use limits value into the ROMs, the following procedure should be followed using the ROM programming form shown in Table 1:

(1) Set up the equipment for normal operation.

(2) Load the use limits gas into the Wilks gas analyzer according to the Wilks instruction manual.

(3) Set the filter wheel position to a blank position preceding the λ 2.5-4.5 scan.

(4) Place the Wilks analyzer in the automatic scan mode.

(5) Press the RESET button on the SSRD.

(6) For each scan address displayed on the SSRD, record the indicated absorption level in binary format on the ROM programming form. Each ON light represents a logic "1".

(7) Repeat the above procedure for the λ 4.5-8 and λ 8-14 segment. Note: The first address recorded is 000001 and the last address is 111111.

(8) This recorded data is then used to program the ROMs and represents the digitized absorption amplitude of the use limit gas sampled.

TABLE 1

ROM PROGRAMMING FORM

L - Denotes Logic 0 Level
H - Denotes Logic 1 Level

	Inputs					Outputs							
	Binary Address												
Word	A_0	A_1	A_2	A_3	A_4	B_0	B_1	B_2	B_3	B_4	B_5	B_6	B_7
						128	64	32	16	8	4	2	1
0	L	L	L	L	L								
1	H	L	L	L	L								
2	L	H	L	L	L								
3	H	H	L	L	L								
4	L	L	H	L	L								
5	H	L	H	L	L								
6	L	H	H	L	L								
7	H	H	H	L	L								
8	L	L	L	H	L								
9	H	L	L	H	L								
10	L	H	L	H	L								
11	H	H	L	H	L								
12	L	L	H	H	L								
13	H	L	H	H	L								
14	L	H	H	H	L								
15	H	H	H	H	L								
16	L	L	L	L	H								
17	H	L	L	L	H								
18	L	H	L	L	H								
19	H	H	L	L	H								
20	L	L	H	L	H								
21	H	L	H	L	H								
22	L	H	H	L	H								
23	H	H	H	L	H								
24	L	L	L	H	H								
25	H	L	L	H	H								
26	L	H	L	H	H								
27	H	H	L	H	H								
28	L	L	H	H	H								
29	H	L	H	H	H								
30	L	H	H	H	H								
31	H	H	H	H	H								

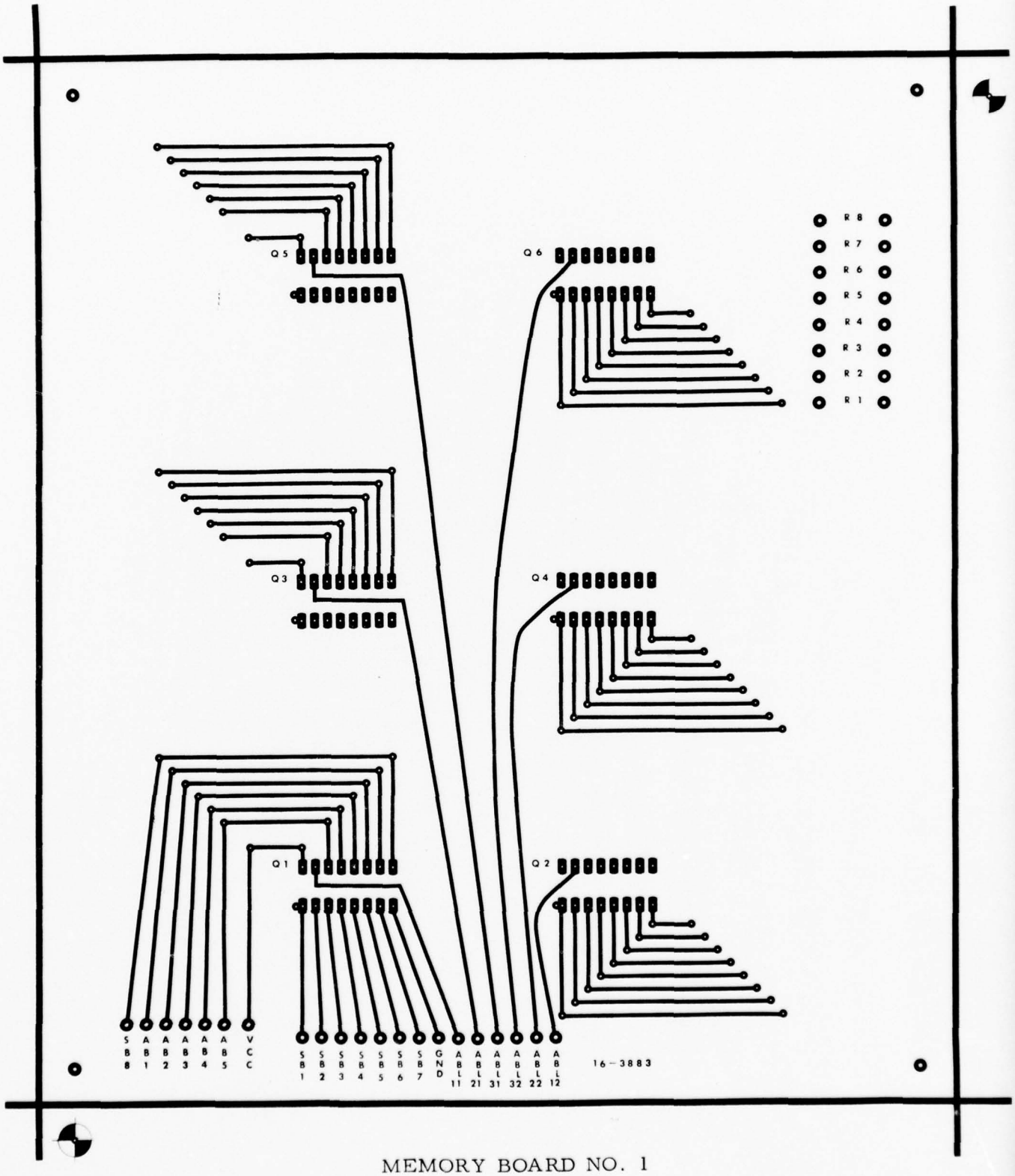
VII. PARTS LIST

PL-3883-0003

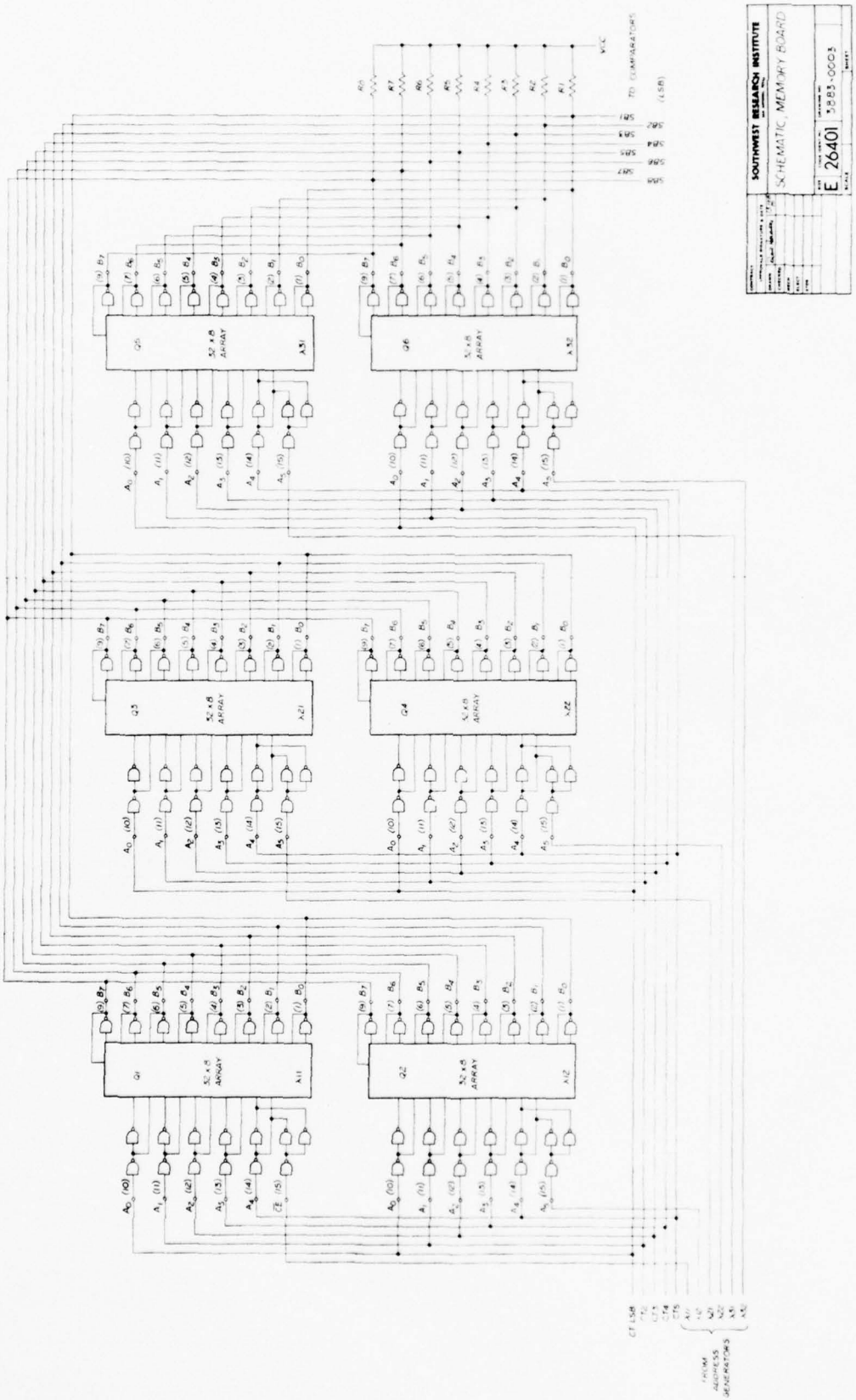
PARTS LIST FOR MEMORY BOARD NO. 1

Board Location	Mfg. -ID	Code ID	Mil. No.	
Q1 - Q6	N8223	18324		PROM
R1 - R8			RCR07-G-102-JS	Resistor 1 K Ohm

TOP VIEW



MEMORY BOARD NO. 1

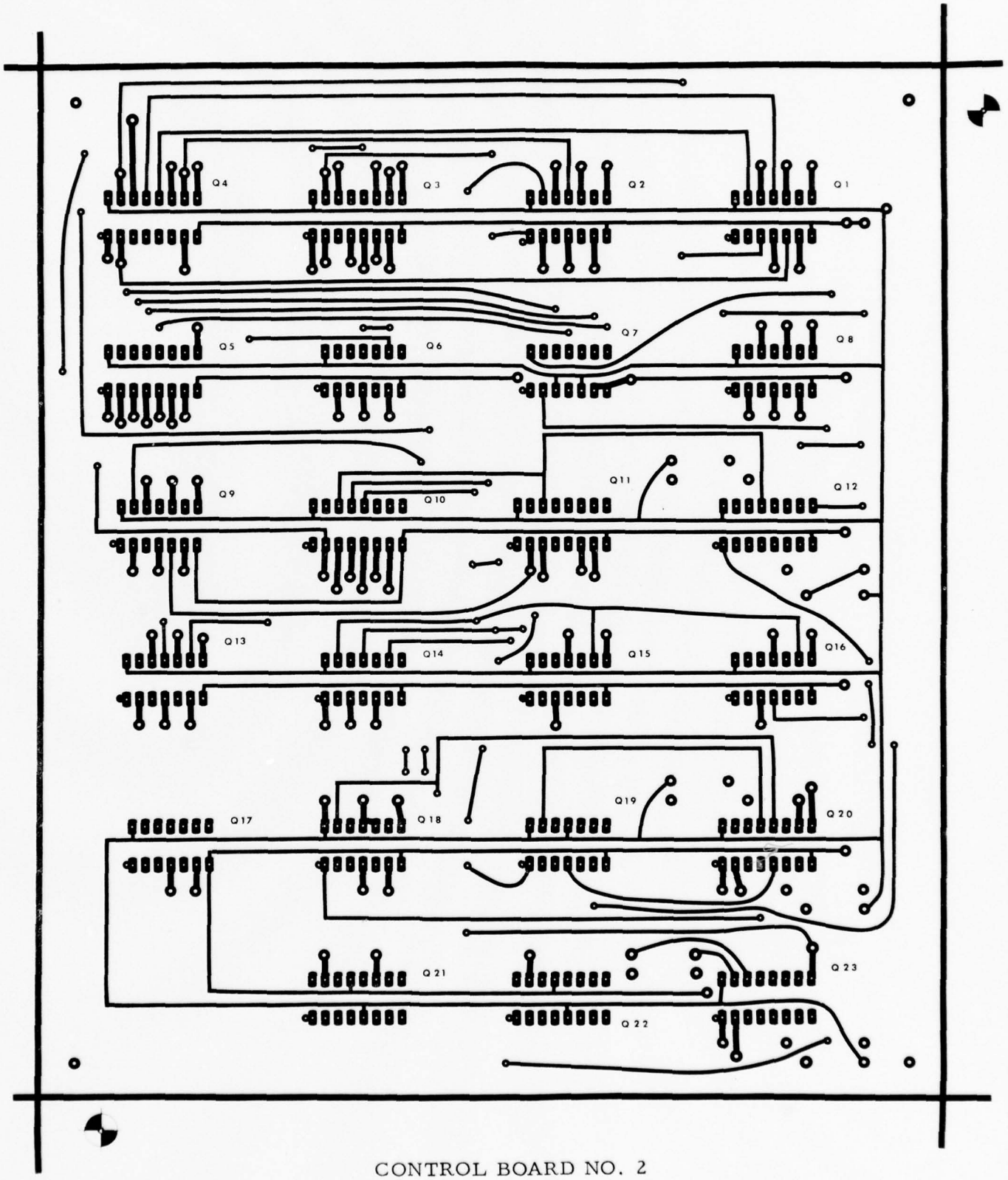

SOUTHWEST RESEARCH INSTITUTE
SCHEMATIC, MEMORY BOARD
E 26401 3885-0003
Q1
Q2
Q3
Q4
Q5
Q6
32 x 8 ARRAY
A11
A12
A21
A22
A31
A32
VCC
TO COMPARATORS
(LSB)
FROM ADDRESS GENERATORS

PL-3883-0004

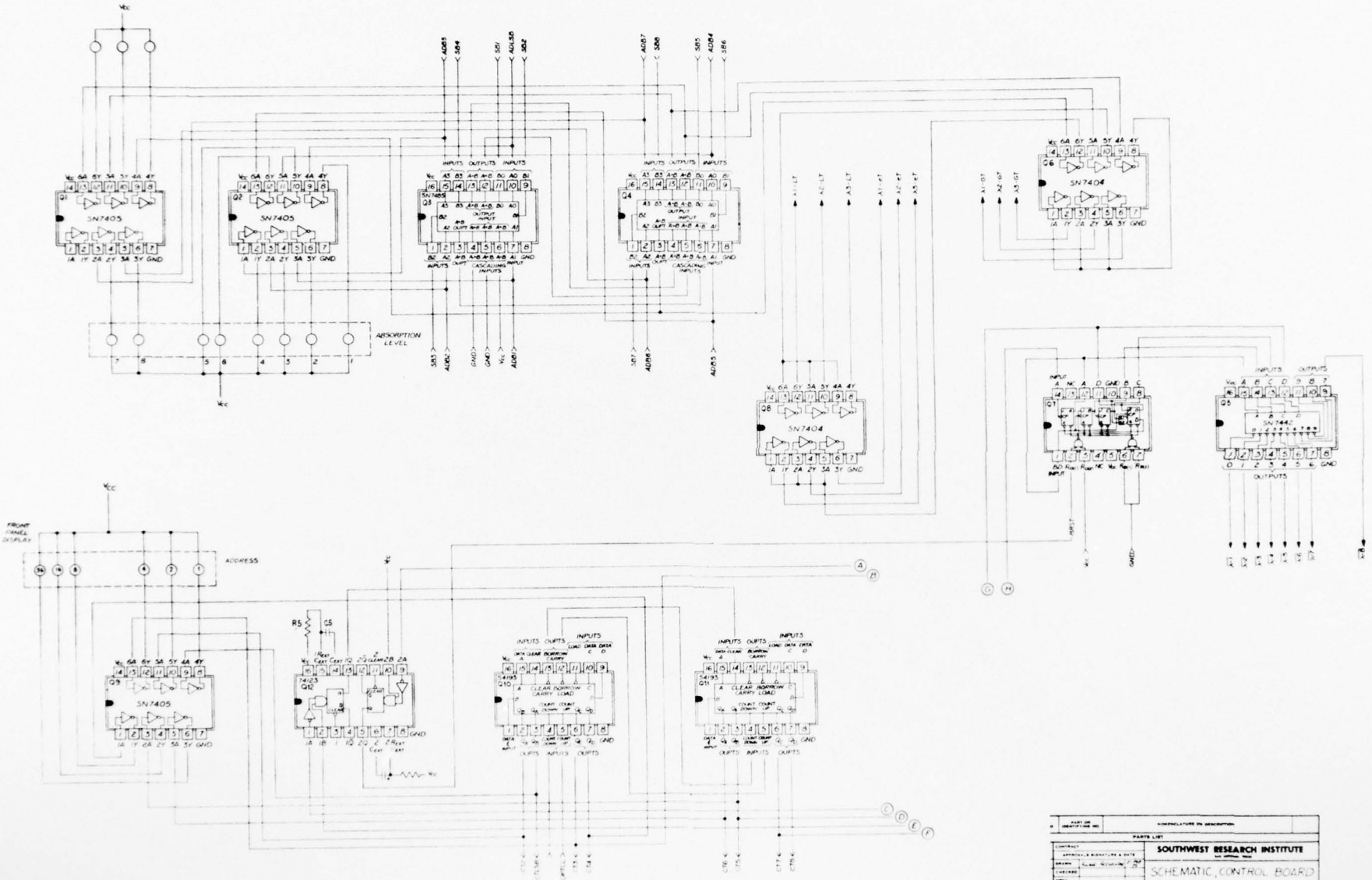
PARTS LIST FOR CONTROL BOARD NO. 2

Board Location	Mfg. -ID	Code ID	Mil. No.	
Q1, Q2, Q9, Q13	SN7405	01295		Hex Inverter Open Collector
Q3, Q4	SN74L85	01295		4-Bit Magnitude Comparators
Q5	SN7442	01295		BCD to Decimal Decoder
Q7	SN5490	01295		Decade Counters
Q10, Q11	SN54193	01293		Synchronous 4-Bit Up-Down Counter
Q12, Q20, Q23	SN74123	01295		Dual Retriggerable Multivibrators
Q15, Q16	SN7400	01295		4 2-Input Positive NAND
Q6, Q8, Q14	SN7404	01295		Hex Inverters
Q19	SN7425	01295		Dual 4-Input Positive NOR
Q17, Q18	SN7437	01295		Quadruple 2-Input Positive NAND
Q21, Q22	SN7476	01295		Dual J-K Flip-Flops
R1-R6			RCR07-G-203-JS	20 K Ohm Resistor
R7			RCR07-G-102-JS	1 K Ohm Resistor
C1 - C6			CM05-FD-911-J03	910 pFd Capacitor

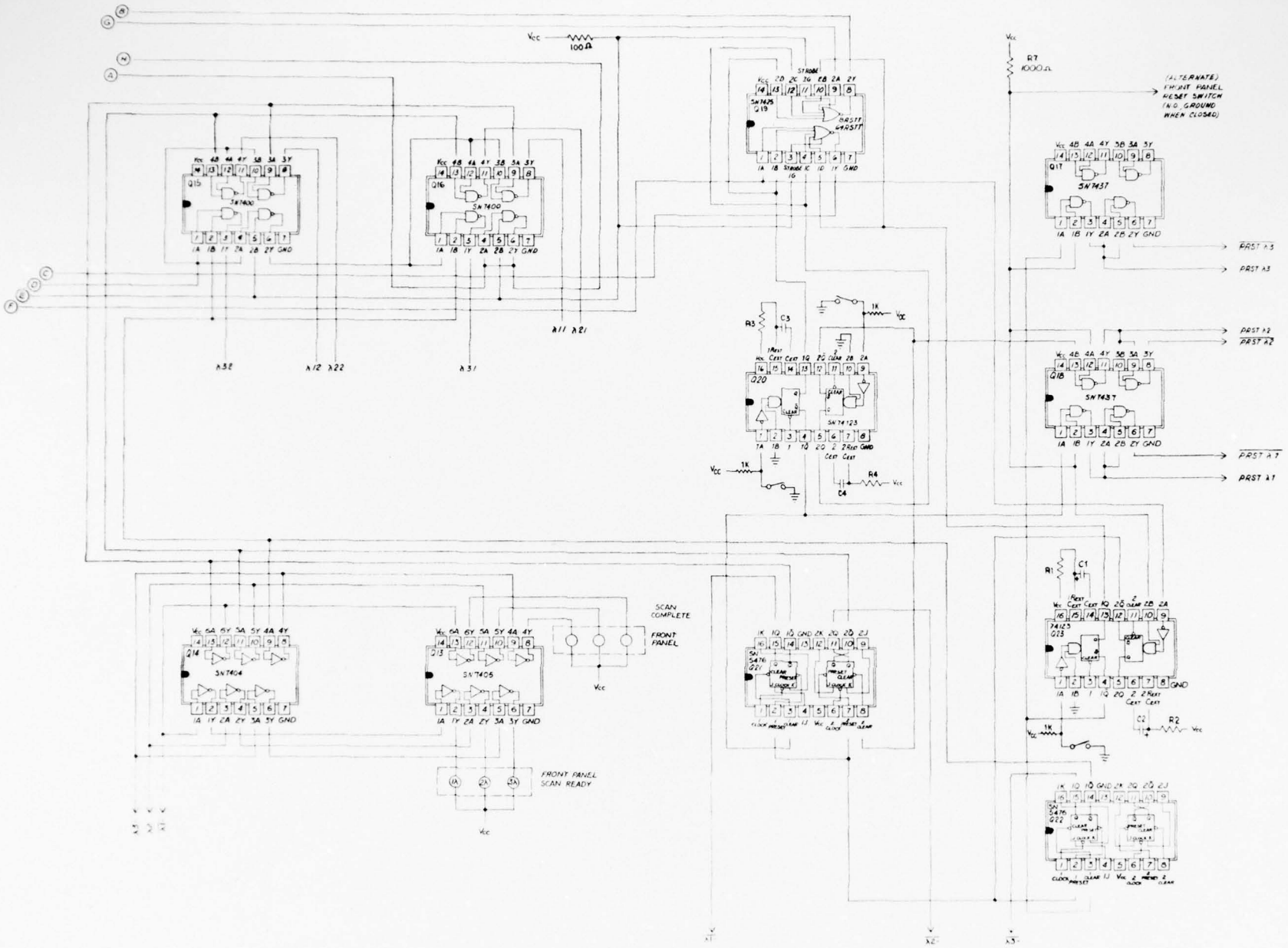
TOP VIEW



CONTROL BOARD NO. 2



CONTRACT	SOUTHWEST RESEARCH INSTITUTE	
APPROVALS & SIGNATURES & DATE		
DRAWN	SCHEMATIC, CONTROL BOARD	
CHECKED		
ISSUED		
RELEASED		
SIZE E	CAGE IDENT NO. 26401	DRAWING NO. 3883-0004
SCALE		SHEET 1 OF 2



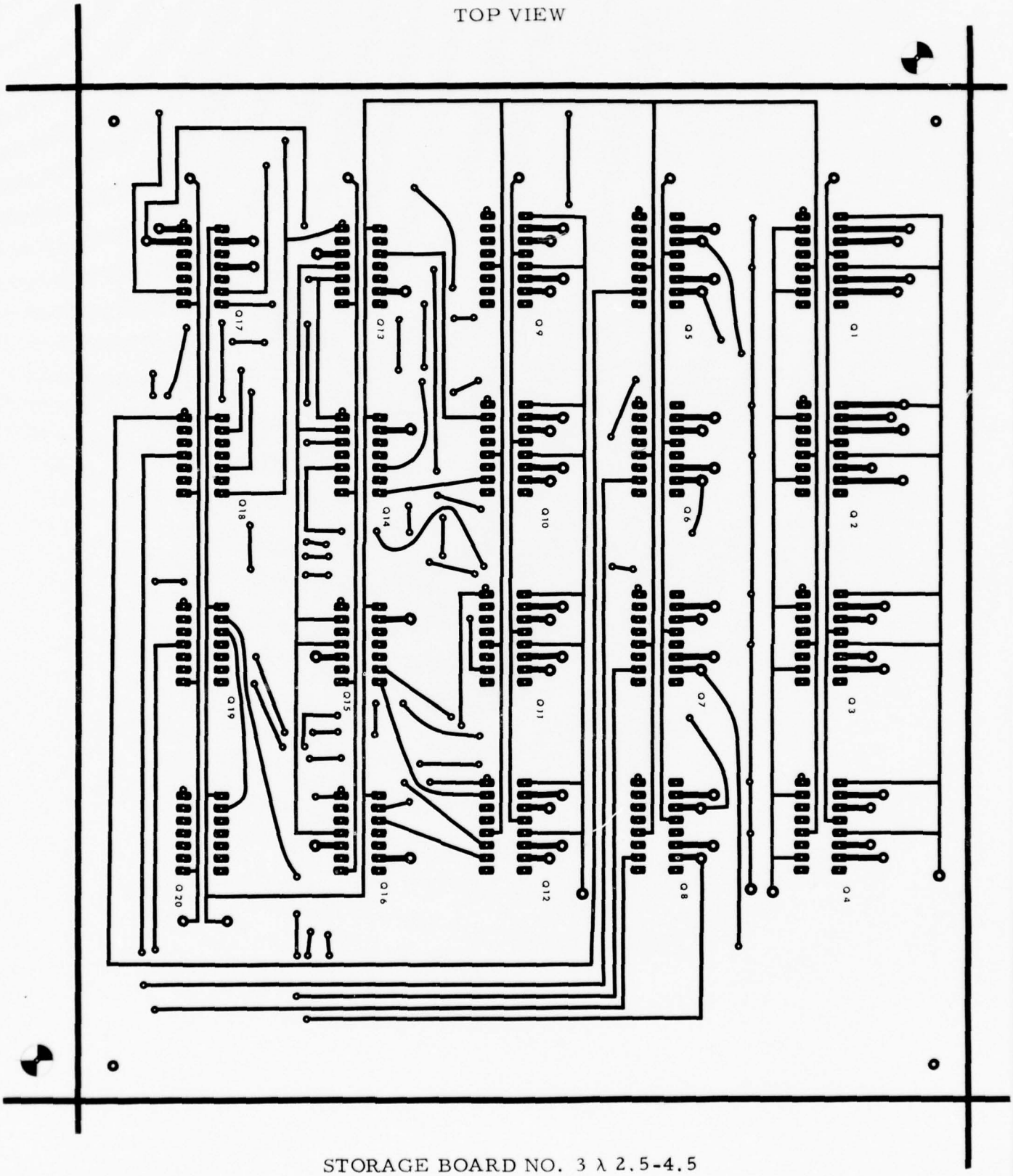
CONTRACT	SOUTHWEST RESEARCH INSTITUTE
APPROVALS, SIGNATURES & DATE	SCHEMATIC, CONTROL BOARD
SIZE E	CODE IDENT NO. 26401
DRAWING NO.	3883-0004
SCALE	SHEET 2 OF 2

PL-3883-0002

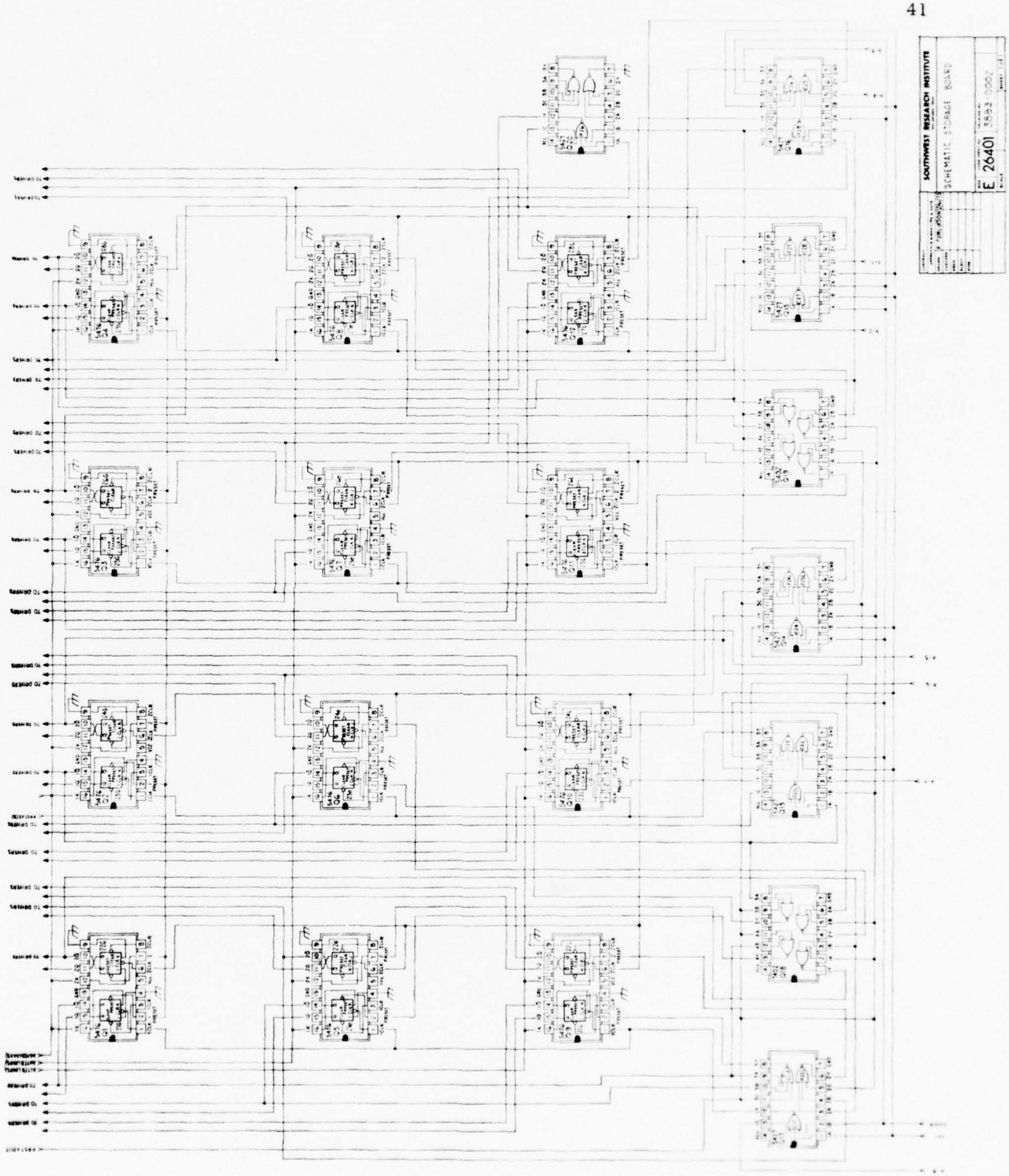
PARTS LIST FOR STORAGE BOARD NO. 3 λ 2.5-4.5

Board Location	- Mfg-ID	Code ID	Mil. No.	
Q1 - Q12	SN5476	01295		Dual J-K Flip Flop
Q13 - Q17, Q20	SN7427	01295		3-Input Positive NOR
Q18 - Q19	SN7402	01295		2-Input Positive NOR

TOP VIEW



STORAGE BOARD NO. 3 λ 2.5-4.5

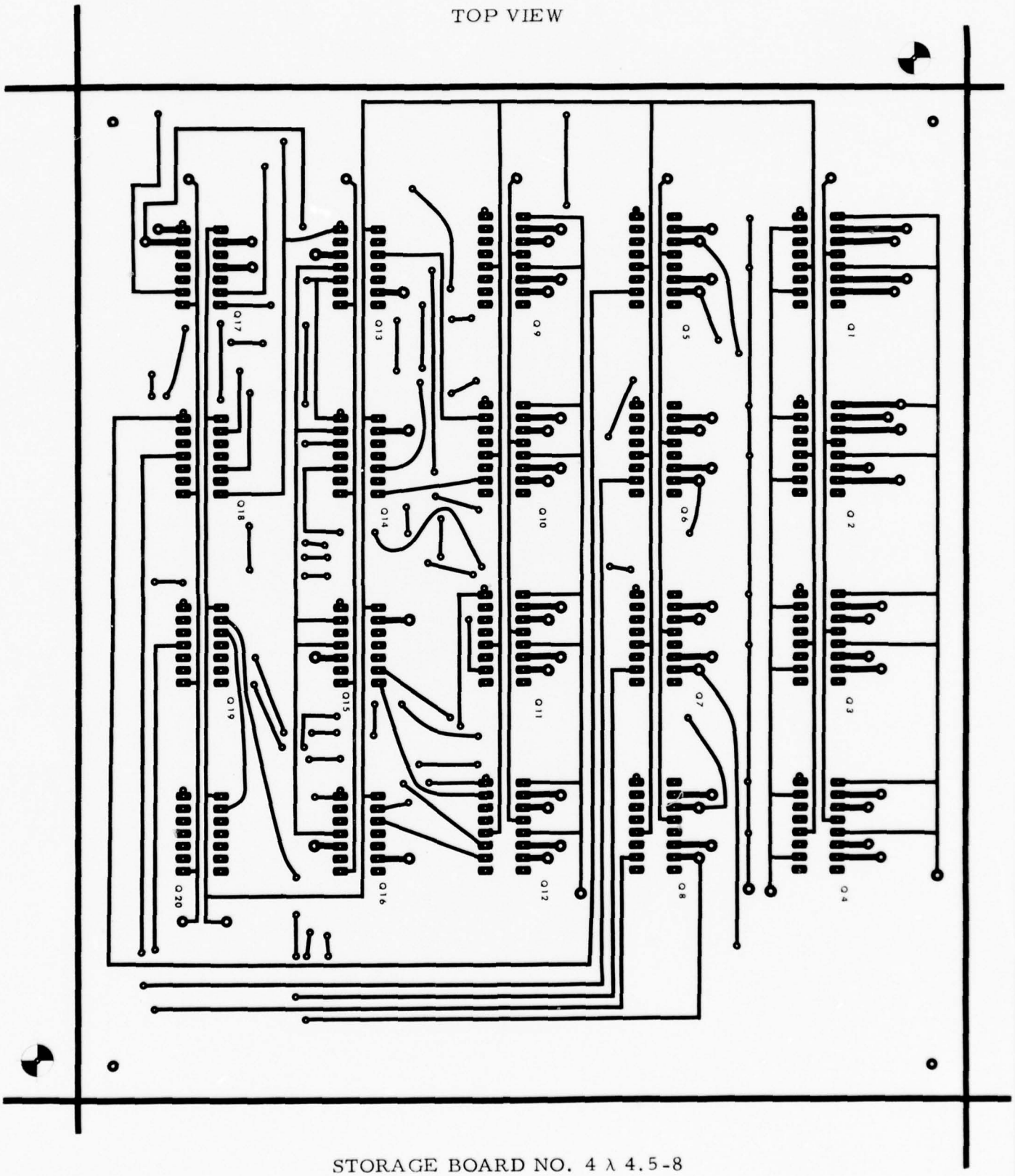

SOUTHWEST RESEARCH INSTITUTE
SCHEMATIC STORAGE BOARD
E 26401

PL-3883-0002

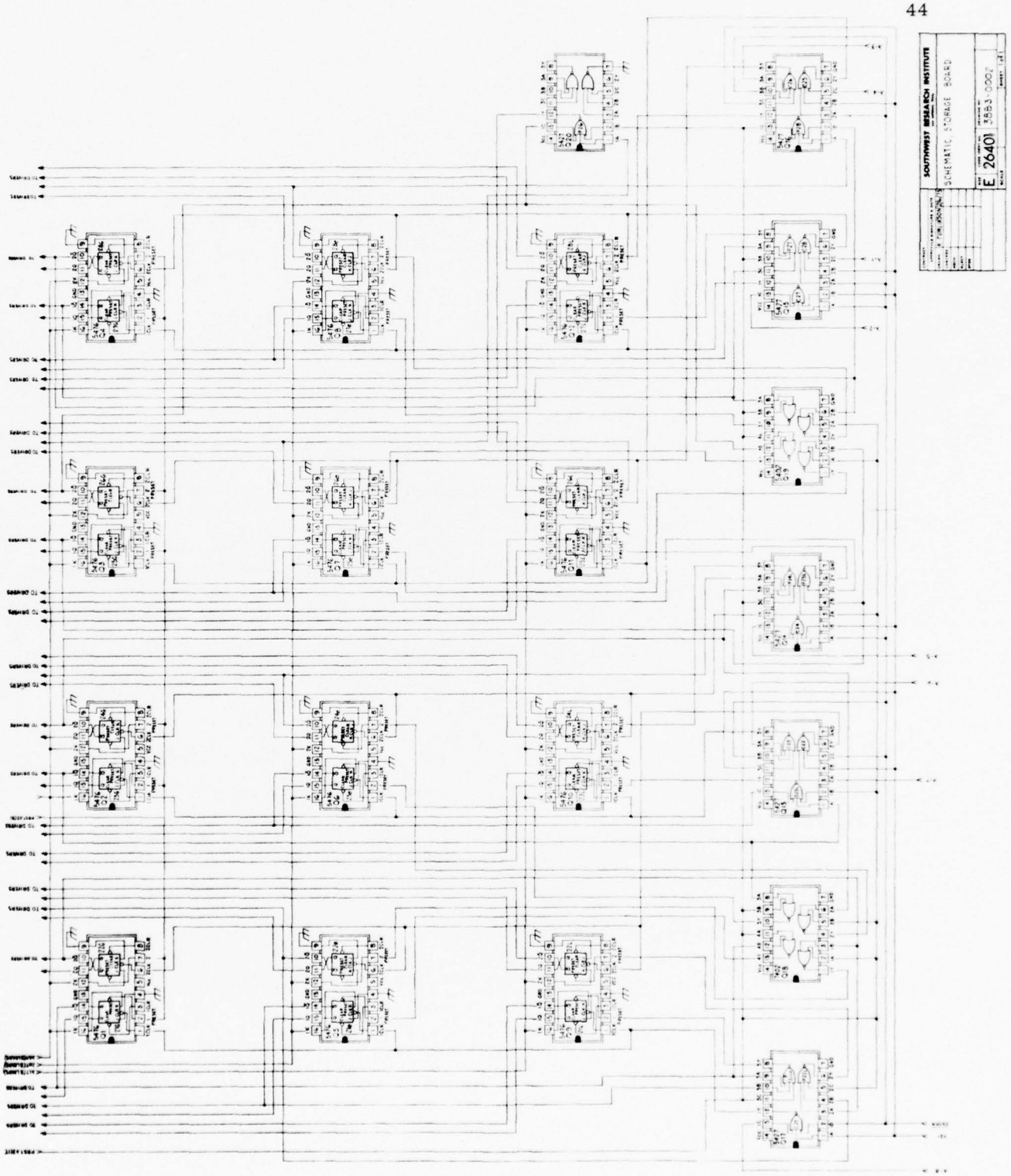
PARTS LIST FOR STORAGE BOARD NO. 4 λ 4.5-8

Board Location	- Mfg-ID	Code ID	Mil. No.	
Q1 - Q12	SN5476	01295		Dual J-K Flip Flop
Q13 - Q17, Q20	SN7427	01295		3-Input Positive NOR
Q18 - Q19	SN7402	01295		2-Input Positive NOR

TOP VIEW



STORAGE BOARD NO. 4 λ 4.5-8

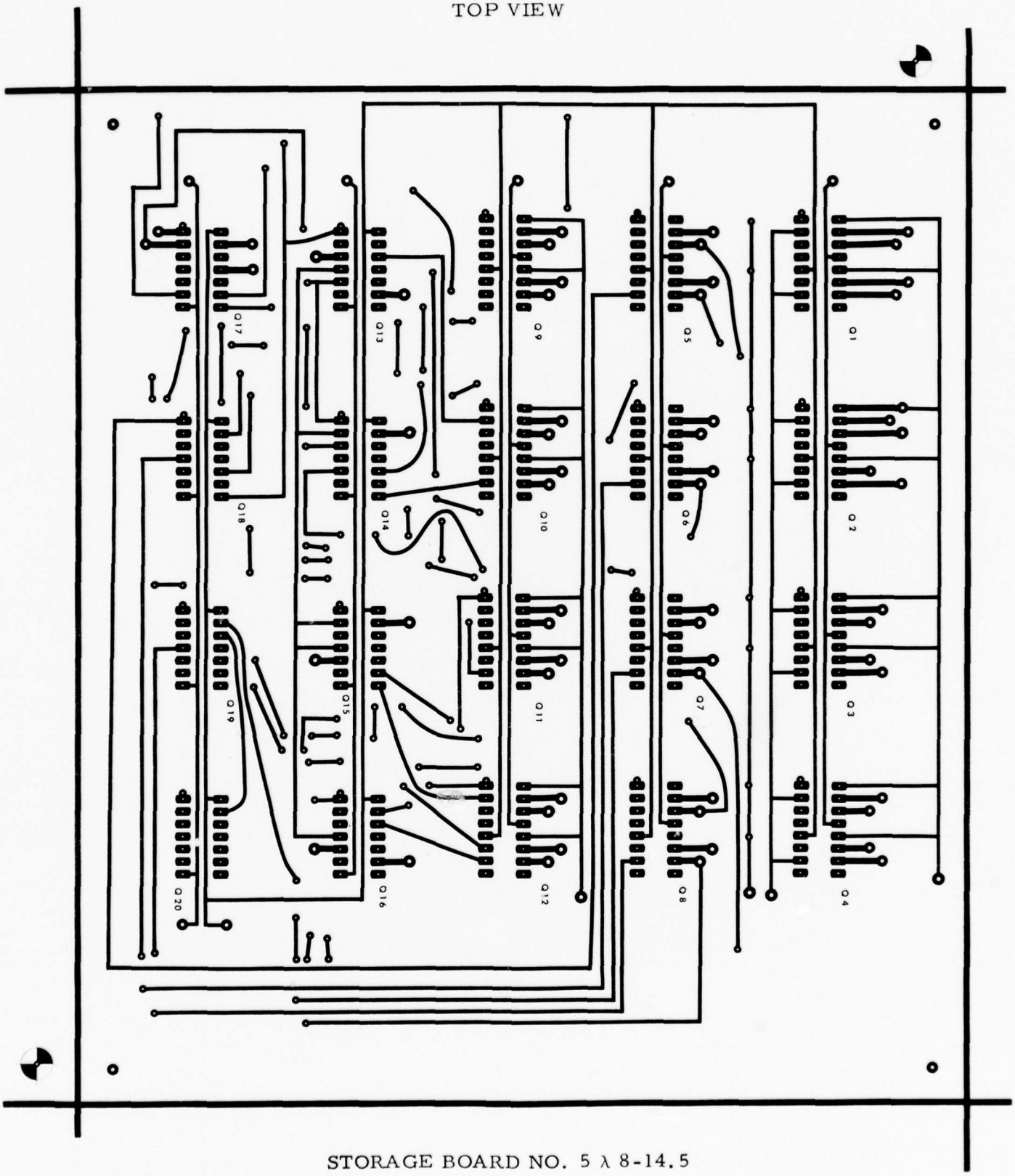

SOUTHWEST RESEARCH INSTITUTE
SCHEMATIC, STORAGE BOARD
E 26401
3853-0002

PL-3883-0002

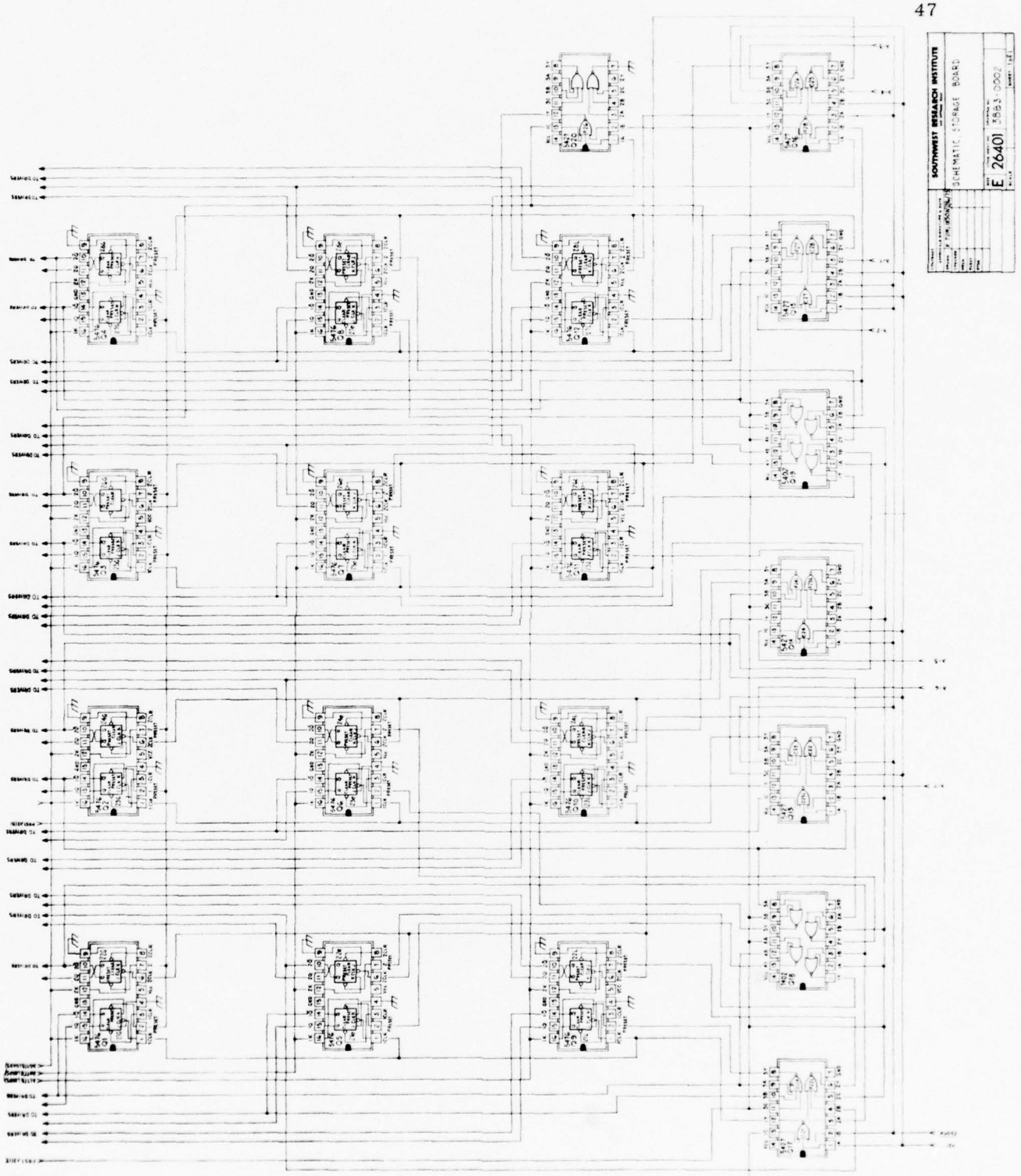
PARTS LIST FOR STORAGE BOARD NO. 5 λ 8-14.5

Board Location	- Mfg-ID	Code ID	Mil. No.	
Q1 - Q12	SN5476	01295		Dual J-K Flip Flop
Q13 - Q17, Q20	SN7427	01295		3-Input Positive NOR
Q18 - Q19	SN7402	01295		2-Input Positive NOR

TOP VIEW



STORAGE BOARD NO. 5 λ 8-14.5

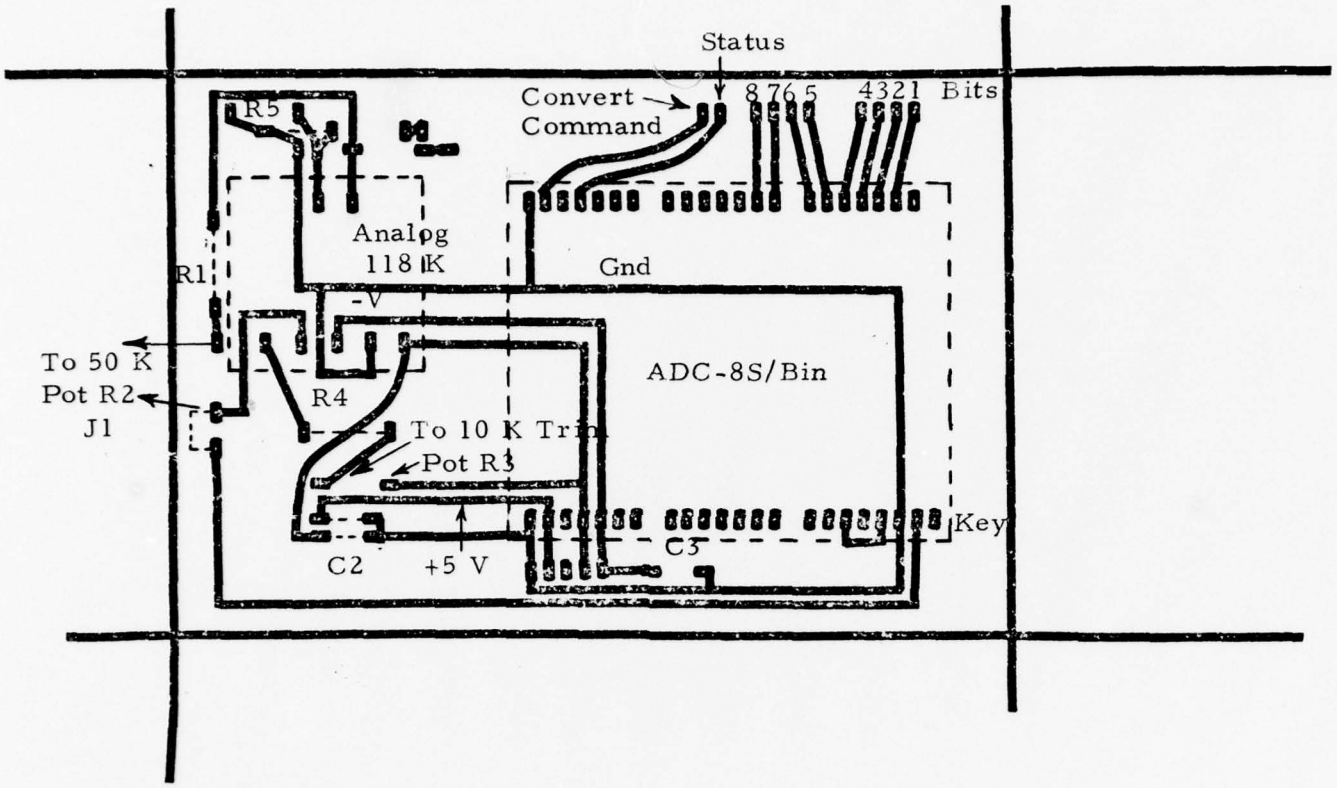

SOUTHWEST RESEARCH INSTITUTE
SCHEMATIC, STORAGE BOARD
E 26401
3851-0002

PL-3883-0006

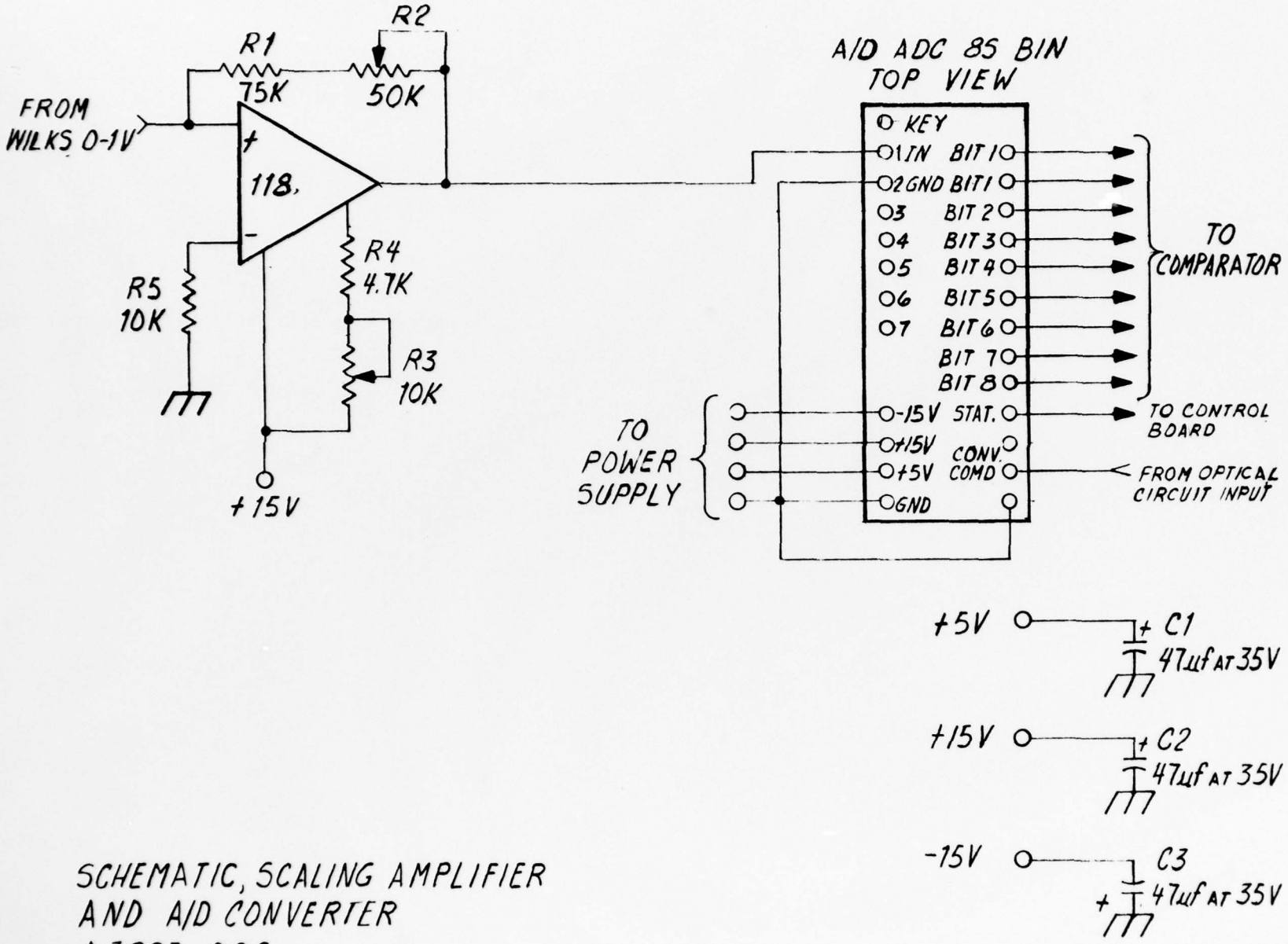
PARTS LIST A/D CONVERTER BOARD NO. 6

Board Location	Mfg-ID	Code ID	Mil. No.	
	A/D ADC 38 Bin	24355		8 Bit A/D Converter
	Analog 118	24355		Operational Amplifiers
R1			RCR07-G-753-JS	75 K Ohm Resistor
R2	Bourns Model 3009Y			50 K Ohm 10-turn Pot
R3	Bourns Model 3009Y			10 K Ohm 10-turn Pot
R4			RCR07-G-472-JS	4.7 K Ohm Resistor
R5			RCR07-G-103-JS	10 K Ohm Resistor
C1 - C3	Sprague Type 198D156X902DK1			47 MFd 20V Capacitor

BOTTOM VIEW



A/D CONVERTER CIRCUIT BOARD NO. 6



SCHEMATIC, SCALING AMPLIFIER
AND A/D CONVERTER
A3883-006

PL-3883-0005

PARTS LIST PHOTO DETECTOR CIRCUIT BOARD NO. 7

Board Location	Mfg-ID	Code ID	Mil. No.	
IC-1	SN7413	01295		Dual 4 input Positive Schmitt Trigger
IC-2	SN7402	01295		Quadruple 2-input Positive NOR
IC-3	SN74123	01295		
Q1	2N930	01295		N-P-N Silicon Transistor
	FPA-102			Fairchild Light Reflection Transducer
R1			RCR07-G-910-JS	91 Ohm Resistor
R2			RCR07-G-113-JS	11 K Ohm Resistor
R3			RCR07-G-112-JS	1.1 K Ohm Resistor
R4, R5			RCR07-G-513-JS	51 K Ohm Resistor
C1, C2	Centralab UK10-204			.2 μFd 10 V Capacitor
C3	Sprague Type 198D156X9020K1			47 μFd 20 V Capacitor

TOP VIEW

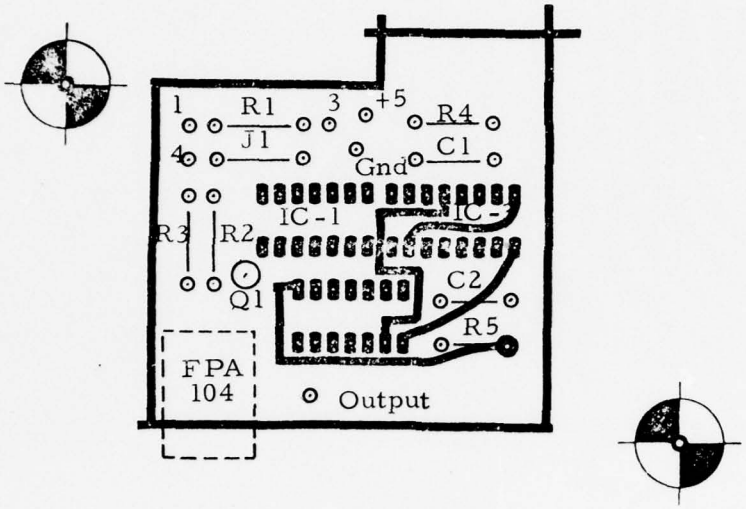
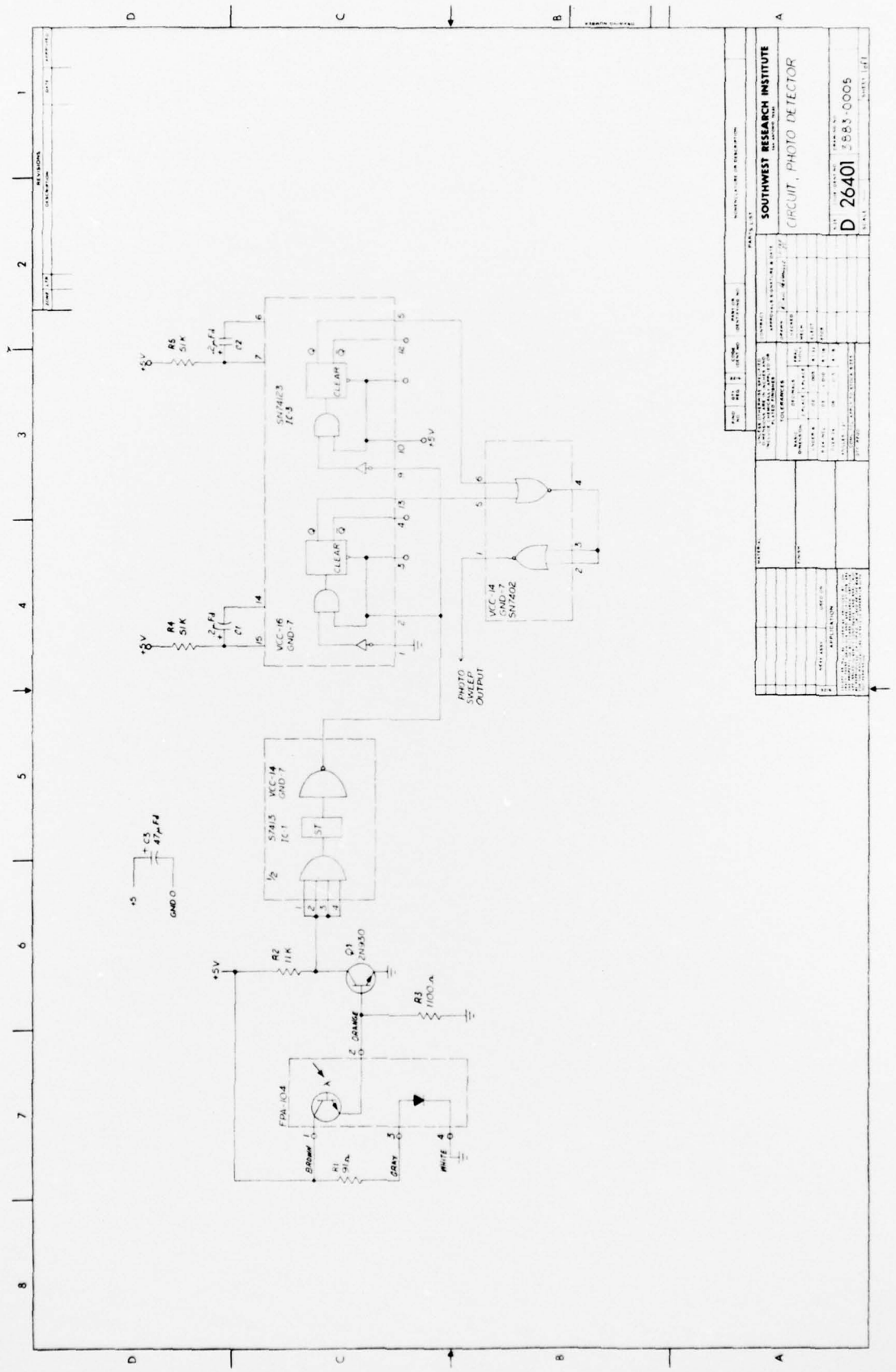


PHOTO DETECTOR CIRCUIT BOARD NO. 7

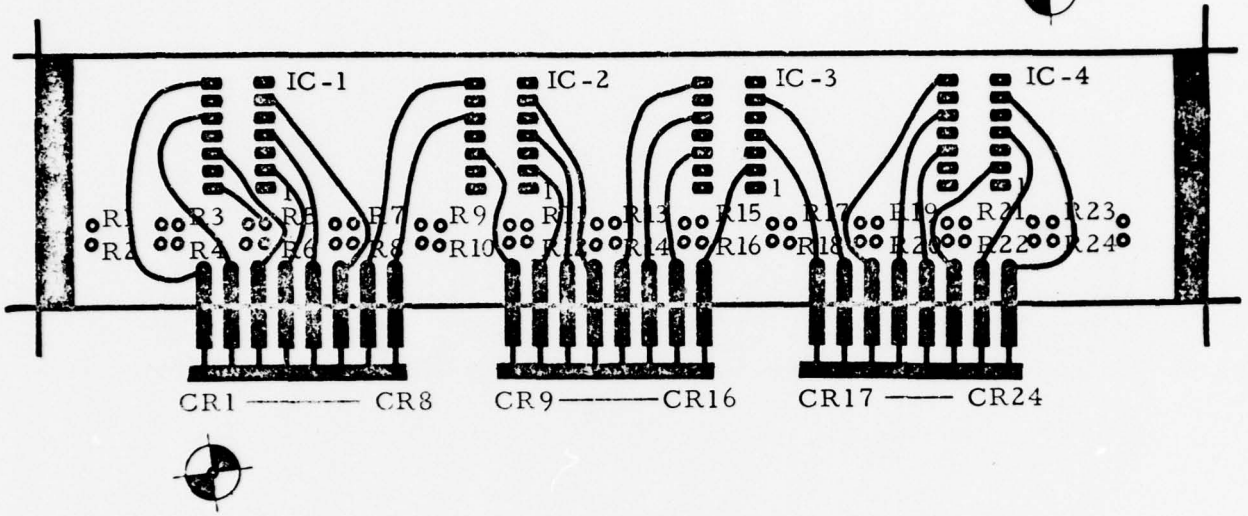

SOUTHWEST RESEARCH INSTITUTE
CIRCUIT, PHOTO DETECTOR
D 26401
R5 51K
R4 51K
R2 11K
R1 1100Ω
R3 91Ω
Q1 2N4250
FPM-104
SN74123 IC3
SN7415 IC1
SN7402
PHOTO SWEEP OUTPUT
+5V
GND 0
BROWN
ORANGE
GRAY
WHITE

PL-3883-0007

PARTS LIST FOR STATUS DISPLAY BOARD NO. 8

Board Location	Mfg-ID	Code ID	Mil No.	
IC1 - IC4	SN7405	01295		Hex Inverter Open Collector
R1 - R24			RCR07-6-181-JS	180 Ohm Resistor
ER24 - CR24	Xcition, XC212			Red Diffused L.E.D.

TOP VIEW



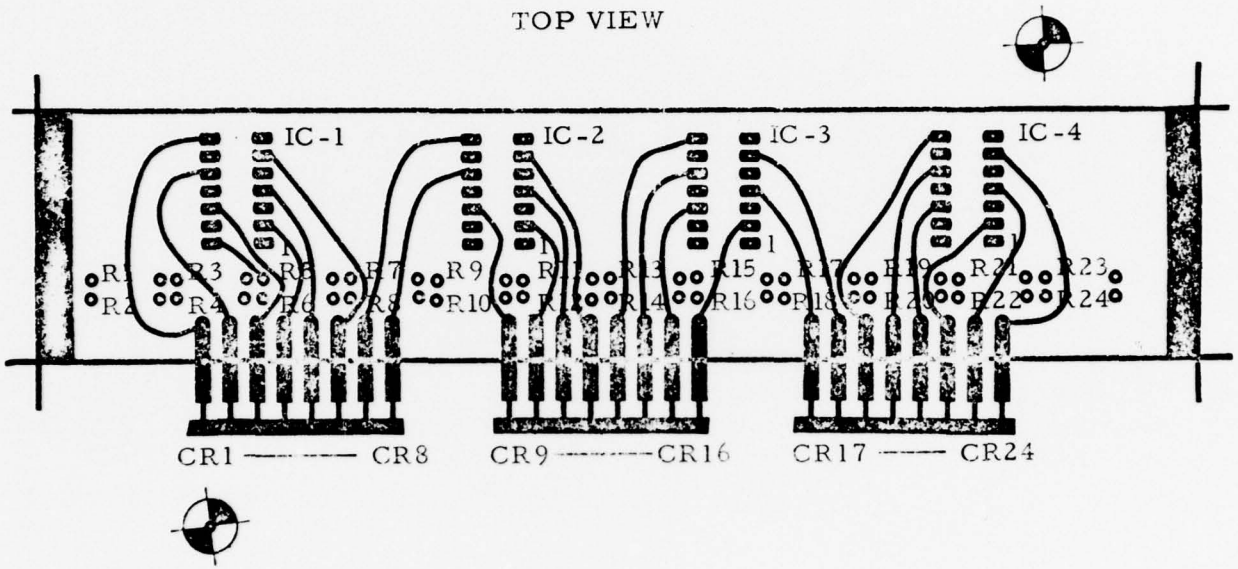
STATUS DISPLAY BOARD NO. 8-10

PL-3883-0007

PARTS LIST FOR STATUS DISPLAY BOARD NO. 9

Board Location	Mfg-ID	Code ID	Mil No.	
IC1 - IC4	SN7405	01295		Hex Inverter Open Collector
R1 - R24			RCR07-6-181-JS	180 Ohm Resistor
ER24 - CR24	Xcition, XC212Y			Yellow Diffused L.E.D.

TOP VIEW



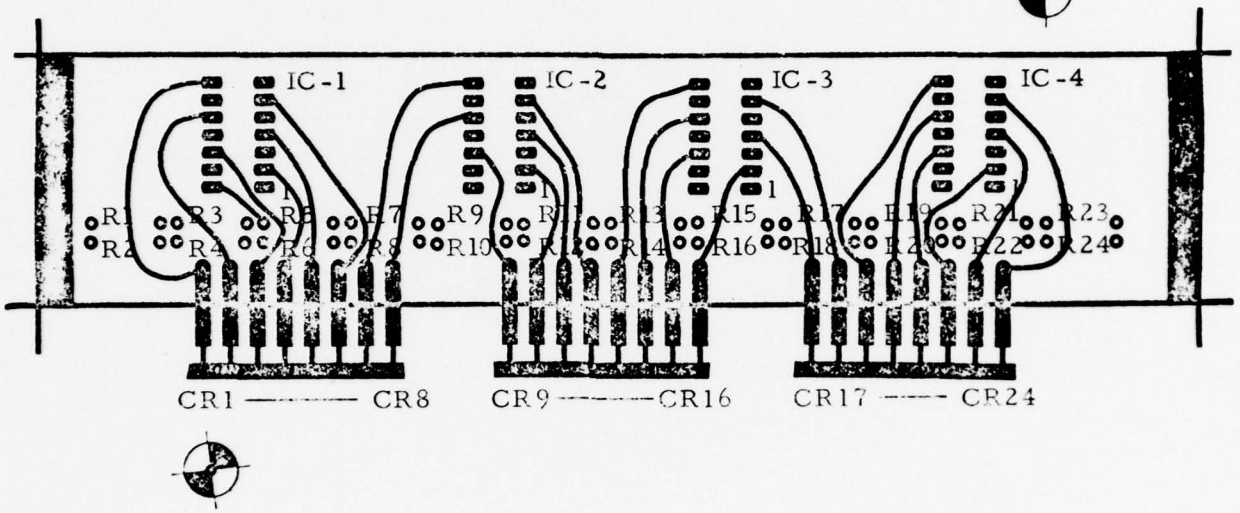
STATUS DISPLAY BOARD NO. 8-10

PL-3883-0007

PARTS LIST FOR STATUS DISPLAY BOARD NO. 10

Board Location	Mfg-ID	Code ID	Mil No.	
IC1 - IC4	SN7405	01295		Hex Inverter Open Collector
R1 - R24			RCR07-6-181-JS	180 Ohm Resistor
ER24 - CR24	Xcition, XC212G			Green Diffused L. E. D.

TOP VIEW

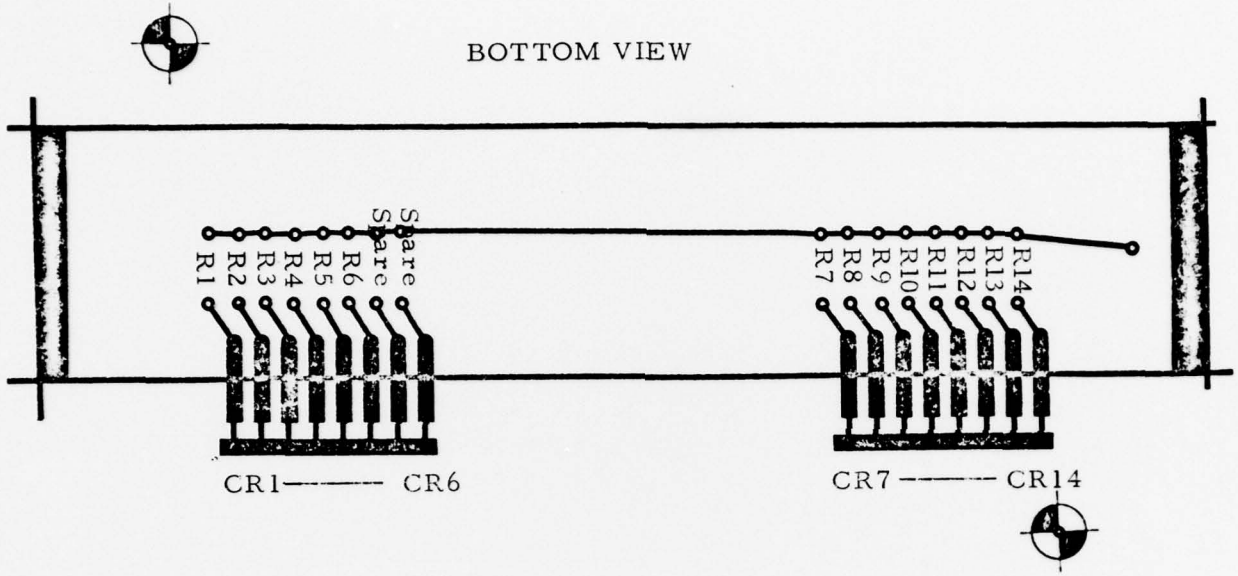


STATUS DISPLAY BOARD NO. 8-10

PL-3883-0008

PARTS LIST FOR ABSORPTION LEVEL AND COUNTER DISPLAY BOARD NO. 11

Board Location	Mfg-ID	Code ID	Mil. No.	
R1-R14			RCR07-G-181-JS	180 ohm Resistor
CR1 - CR14	Xcition, XC212Y			Yellow Diffused L. E. D.



ABSORPTION LEVEL AND COUNTER DISPLAY BOARD NO. 11

PL-3883-0009

PARTS LIST FOR ROM PROGRAMMER

Board Location	Mfg-ID	Code ID	Mil. No.	
R1			RCR07-G-102-JS	1 K Ohm Resistor
R2			RCR07-G-112-JS	1.1 K Ohm Resistor
R3			RCR07-G-202-JS	2 K Ohm Resistor
R4			RCR07-G-391-JS	390 Ohm Resistor
R5			RCR07-G0153-JS	
R6			RCR07-G-822-JS	
R7			RCR07-G-392-JS	
R8			RCR07-G-271-JS	
C1	Sprague Type 198D105X9035H1			1 mFd 35 V Capacitor
C2	Sprague Type 198D156X9020K1			47 mFd 20 V Capacitor
Q1	2N4236	01295		Transistor
Q2, Q3	2N2222	01295		Transistor
IC-1	SN74121	01295		Monostable Multivibrator
LED1, LED2	Monsanto MV-5020			Red L.E.D.
S1 - S8	Micro 6A2011			2 Pole Double Throw Toggle Switch
S10, S11	Grayhill Type 4001 N.O.			Single Pole Momentary Switch
S9	Centralab PA-300 with a PA-31 Augat Socket Augat Socket Bud AC-402			Index assembly with 1 pole 11 position water assembly 14 pin IC 16 pin IC Aluminum Chassis

PARTS LIST MISCELLANEOUS

Board Location	Mfg-ID	Code ID	Mil. No.	
S1 - S4	SA25SAT112-7	27191		Cutler Hammer Momentary Switch
S5	SF5SCW191-5			Cutler-Hammer On-Off Switch
P1	Semiconductor Circuits Model 1.5.700/2.15.100			5 Volt 700 ma and +15 Volts and -15 Volts at 100 ma Power Supply
P2	Acopian Model 5K250			5 Volt + 2.5 Amp Power Supply
	Little Fuse Type 342012			Standard Fuse Holder
F1	Little Fuse Type 3AG-313.500			.500 Amp Fuse-Show Blow
	Microtech FP12S-1			12 Pin Miniature Plug (Female)
	Microtech F$12S-6			12 Pin Miniature Plug (Male)
	Zero 030512-21-X			Enclosure VIP
T1	Allied No. 705-0165			Isolation Transformer
	Belden BR-3235			AC Power Cord